Part 2

A Newborn Health Management Information System

PART TWO

A Newborn Health Management Information System

MESSAGES FOR PART TWO

1. Understand the importance of information in decision-making for newborn health programming and the difference between data and information.

2. Learn some of the basic principles of epidemiology needed for newborn health programming, especially the count-divide-compare cycle.

3. Understand the three basic steps in building an HMIS for newborn health and how to apply them.

Response:	What decisions do I need to make?
Analysis:	What questions do I need to answer to make the decisions?
Collection:	What data do I need to collect in order to answer these questions?

4. Learn about the BABIES management tool for newborn health, its advantages, how to build and adapt the matrix, and how to use it to aid in decision-making in the four steps of the step-by-step approach for newborn programming.

5. Appreciate the importance of quality in program management and learn about some tools and approaches to improve quality as a team.

TERMINOLOGY

TERMINOLOGY FOR PART TWO

Action plan: A plan for the implementation of the countermeasure(s) showing who takes what actions, when they take them, where they take them, and how they are taken.

BABIES (Birth Weight and Age-at-death Boxes for an Intervention and Evaluation System): An adaptable assessment tool that allows the program manger to collect, organize, analyze, and translate data into information for newborn health intervention. It uses two pieces of data: age at the time of death of the fetus/ newborn and birth weight group.

C-D-C (count-divide-compare): A cycle of activities in applied epidemiology that starts by counting events and then uses division to form ratios, proportions, and rates in order to compare populations in time, place, and person. The purpose is to promote action to solve a health problem.

Consensus: An agreement to support a decision arrived at by the team; it implies willingness to standby the action taken by the team.

Countermeasure: A proposed solution to a problem.

Countermeasure matrix: A matrix of factors to help team members show the relationship among the problem statement, root causes, countermeasures, and practical methods to overcome the problem.

Fishbone: A graphic composed of lines and words to represent a meaningful relationship between an effect and its causes and to identify a cause upon which the team can take action.

HCDS (health care delivery system): Includes all people who provide and receive services (i.e., communities, local providers, health institutions, and the intersectoral system)

HMIS (health management information system): An adaptable system that collects, analyzes and responds to data about the occurrence and distribution of health outcomes for a population within a given geographical location, and links these outcomes with other relevant data that are translated into information to manage the activities to improve health outcomes.

Management: A process by which one plans, implements, and evaluates an organized response to a health problem.

Process: A repetitive and systematic series of actions or operations where resources are used to develop or deliver products or services.

Quality management: A process to ensure patient or client satisfaction through involvement of all employees in reliably producing and delivering quality products or services.

Quality tools: A method or technique used in the quality management process to assist a team to solve a problem.

Team: A high-performance task group whose members are interdependent and share common performance objectives and whose purpose is to improve the quality of products and services.

Part 2 HMIS

I. PRINCIPLES FOR USE OF INFORMATION IN NEWBORN PROGRAMMING

PROGRAMMING PRINCIPLES FOR NEWBORN HEALTH

- **PRINCIPLE 1**
  Rights of the mother and baby to be counted and to have a record.
- **PRINCIPLE 2**
  A systems approach involving all components of the health care delivery system (HCDS).
- **PRINCIPLE 3**
  Adaptable health management information system (HMIS).
- **PRINCIPLE 4**
  A step-by-step approach: the program management cycle.

Program managers want to "do" something. They plan, implement, and evaluate organized responses to perceived problems. Each decision in the management process requires information. The programming principles for newborn health were laid out in the introduction. Principle 3 deals with the importance of information.

The overall objective of a health management information system (HMIS) is to provide information that can enable program managers to implement effective programs to improve the health of a population. An HMIS is not intended to be a stand-alone entity that makes demands on programs. It is most effective when it supports all the levels of the health care delivery system (HCDS) to translate data into information for program decision-making. This manual does not promote a separate system for the newborn. Data on fetal and neonatal health should be integrated into the existing HMIS to reduce the burden of collecting and analyzing the data. An HMIS that includes data on the newborn can be built in a simple, economical way that includes data from both the community and health facilities. This information can serve as the basis for decision-making at the community, district, and highest levels of the ministry.

Often program managers do not get the information that they want, what they want is not what they need, and what they need, they do not know how to get. Program managers often ask themselves the question, *What am I doing that I can measure?* That is the wrong question. Instead they need to ask, *What is it that I need to measure in order to know what to do?* Part Two suggest simple measurements and other data to be collected that form an essential database for the newborn program. The manual is designed to help the program manager determine what is needed in a given setting and to show the program manager how to translate data into information. Part Three will discuss how to use the information in newborn health programming.

Section II introduces some basic concepts and tools used in *epidemiology,* the study of factors that influence health in a community. The count-divide-compare (CDC) cycle is a basic approach to applied epidemiology. At the village level everyone counts. Dividing by the appropriate denominator enables the program manager to make comparisons that are needed for decision-making in designing and implementing a program.

Section III introduces a basic, simple structure of an HMIS that can be implemented in low-resource settings. This section provides the program manager with the means to strengthen the existing HMIS by incorporating data on maternal, fetal, neonatal health into a complete system. This flexible approach allows the collection of data from both the community and the health facilities to gain insight into all of the issues related to maternal, fetal and neonatal health. The system will focus on translating data into information. Program managers are **data rich, but information poor** because either they do not have the right data to make useful decisions, or the data that they do have are not being transformed into useful information that can be used for decision-making. By using simple epidemiological and quality management principles, program managers can transform the data into information for decision-making. Senior Ministry of Health personnel can use the same data to make important decisions on policy, major resource allocation, and human resource development.

Section IV describes the BABIES matrix, a useful tool in the step-by-step approach for programming in newborn health. BABIES can be used at each level of the HCDS. It is also easily linked with other data and the managerial processes so that it can serve as the foundation of the newborn component of the HMIS.

Section V describes basic principles for quality management of services. Quality management is based on the premise that quality is *everyone's responsibility.* For this approach to be effective, dedication and commitment are needed at all levels of the organization. Some tools used in quality management are described.

Outcome rates get worse before they get better
A program manager can expect initially to have important outcome indicators worsen. Experience shows that as the HMIS improves the number of unreported and unregistered deaths will decrease. As a result of a better functioning HMIS, the reported mortality and morbidity rates will rise, due to increased reporting. This rise should be expected. Sadly, in certain situations, a rise in the infant morality rate has resulted in pay cuts or even dismissal for medical staff because of supposedly poor performance. This consequence is a strong disincentive to report maternal, fetal, and neonatal deaths. Acknowledging that the rate will increase is one way to avoid that situation. To overcome such a dilemma, international agencies should positively encourage countries to accurately define the magnitude of maternal and perinatal deaths even if the result is a significant increase in the maternal, perinatal, and infant mortality rates.

Part 2 HMIS

BASIC EPIDEMIOLOGICAL DEFINITIONS

Epidemiology: The study of the distribution and determinants of health-related states and events in populations, and the application of this study to control of health problems.

Denominator: The population at risk in the calculation of a rate or ratio. The lower portion of a fraction.

Incidence: The number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. More generally, the number of new events, i.e., new cases of a disease in a defined population, within a specified period. The term is sometimes used to denote incidence rate.

Incidence rate: A measure of the rate at which new events occur in the population. The number of new events, i.e., new cases of a specified disease diagnosed or reported during a defined period of time, is the numerator, and the number of persons in the stated population in which the cases occurred is the denominator.

Numerator: The absolute number of events. The upper portion of a fraction.

Population attributable risk: A measure of the amount of disease associated with an exposure within a population.

Prevalence: The number of instances of a given disease or other condition in a given population at a specified time.

Prevalence rate (ratio): The total number of all individuals who have an attribute or disease at a particular time (or during a particular period) divided by the population at risk of having the attribute or disease at that time or midway through the period.

Proportion: A type of ratio in which the numerator is included in the denominator. The important difference between a proportion and a ratio is that the numerator of a proportion is included in the population defined by the denominator, whereas this is not necessarily so for a ratio.

Rate: A ratio whose essential characteristic is that time (per minute, per hour, etc) is an element of the denominator and in which there is a distinct relationship between numerator and denominator. The numerator may be a measured quantity or a counted value.

Ratio: The value obtained by dividing one quantity by another; a general term of which rate, proportion, percentage, prevalence, etc., are subsets.

Risk Ratio: The ratio of the risk of disease or death among the exposed to the risk among the unexposed; this usage is synonymous with relative risk.

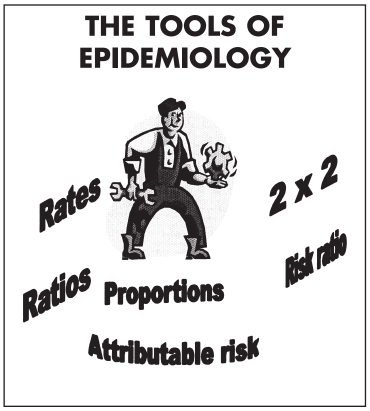
Variable: Any quantity that varies. Any attribute, phenomenon, or event that can have different values.

Variable, dependent: A variable the value of which depends on the effect of other variables [independent variables] in the relationship under study. A manifestation or outcome whose variation we seek to explain or account for by the influence of independent variables.

Variable, independent: The characteristic being observed or measured that is hypothesized to influence an event or manifestation (the dependent variable) within the defined area of relationships under study; the independent variable is not influenced by the event or manifestation but may cause it to contribute to its variation.

Source: U.S. Department of Health and Human Services. Program Management: A Guide for Improving Program Decisions: CDC Atlanta, GA 1986[1]. Last, J.A. (ed). Dictionary of Epidemiology. New York: Oxford University Press. 1983[2].

II. BASIC EPIDEMIOLOGICAL SKILLS FOR NEWBORN HEALTH PROGRAMMING



Epidemiology is the study of the distribution, frequency, and determinants (factors) of health problems in defined populations. The application of epidemiological tools and concepts can be used to assist program managers in understanding and addressing major health problems. Epidemiological tools are useful to identify the major causes of morbidity and mortality, a step toward effective interventions to prevent or treat those causes.

The main aims of epidemiology are to:

- ✤ describe and classify diseases in population groups by time, person, and place to make community diagnoses and set priorities for action;
- ✤ identify disease determinants in order to enable prevention rather than just offer curative measures; and
- ✤ provide information for planning and evaluating health care interventions through analysis of data.

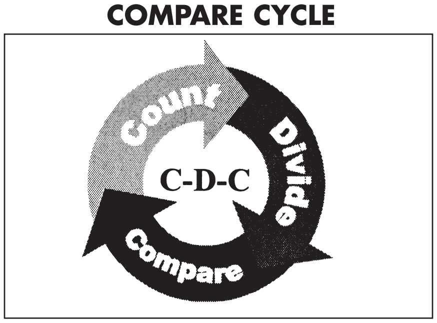
Every health program manager must count, divide, and compare - the basic cycle of applied epidemiology. Within this cycle, there are seven basic epidemiological skills that a program manager requires to make programmatic decisions.

The *count* component includes:
- the ability to distinguish when to use counts, ratios, proportions, and rates.

The *divide* component includes:
- the ability to calculate rates, ratios, and proportions.

The *compare* component includes:
- the ability to understand and use a 2x2 table in processing and analyzing data;
- the ability to use a rate, ratio, or proportion to compare populations;
- the ability to evaluate the "strength" of a risk factor (risk ratio, or odds ratio);
- the ability to estimate the effect of a risk factor on the population by using population attributable risk percent (PAR%); and
- the ability to describe an adverse outcome by time, person, and place using three way tabulations.

FIGURE 2.1
COUNT, DIVIDE, COMPARE CYCLE



A. The Count-Divide-Compare (C-D-C) Cycle

At the Centers for Disease Control and Prevention, CDC stands for more than just its name. It also is an acronym that summarizes what applied epidemiology does: count, divide, and compare (Figure 2.1). The program manager should seek and provide sufficient resources to **count** on a population basis, so that the **division** is a rate, thereby making the **comparison** worthwhile for decision-making.

Part 2 HMIS

C-D-C Action 1: Count

At the community level counting is often quite easy. Addition (or subtraction) are daily events performed by everyone, even children. Birth and death counts, a basic function of a government's vital registration systems, enables health care workers to respond to a community's needs. Infectious disease counts often lead to recognition that an epidemic is in progress, particularly in an outbreak in which the population is well-defined, stable, and restricted in time. The community responds better to counts, particularly if the count has a "face." In Section IV, the community monitoring board illustrates how a count (represented by a pin) can be used to monitor the current status of pregnant women, mothers, and babies.

Throughout this section, a series of figures with important epidemiological definitions are given in the order in which they are used in epidemiology. The first figure is an example that will be used throughout this section to provide a practical illustration of the calculations of the different measures in epidemiology that are related to the count, divide, and compare cycle.

FIGURE 2.2
EPIDEMIOLOGICAL EXAMPLE

EXAMPLE	Region A had 2,000 live births in the year 2000. Of 70 neonatal deaths, 20 deaths were due to asphyxia, and 10 of the deaths were in 25 mothers with eclampsia. Three of five maternal deaths were due to eclampsia. Region B had 4,000 live births in 2000. Of 80 neonatal deaths, five deaths were due to asphyxia, and five of the deaths were in 40 mothers with eclampsia. There was one maternal death due to sepsis.

C-D-C ACTION 1: COUNT

SKILL 1. The Ability to Distinguish When to Use Counts, Ratios, Proportions, and Rates.

All program managers count. Counts provide the magnitude of their service load and a means to manage their program. Counts are also the first step in an epidemiological description and analysis of a health problem. Without an ability to count accurately, subsequent conclusions are often misleading, or even wrong. Counts are most often described with one characteristic, i.e., the number of antenatal visits, the number of males or females, the number of low birth weight babies, or the number of neonatal deaths. Later in this section, counts are described and organized in a table with each count having at least two characteristics. This table will form the building block of the program manager's epidemiological analysis.

FIGURE 2.3
EPIDEMIOLOGICAL DEFINITION: COUNTS

COUNTS

Count: The absolute number of cases or events related to a health outcome, i.e., maternal deaths, neonatal deaths.

From Figure 2.12: Cells a, b, c, and d are counts.

From Figure 2.2: Region A had 70 neonatal deaths, and Region B had 80 neonatal deaths. Region B had more neonatal deaths than Region A. Which region has more of a problem? To answer this question, the program manager has to divide.

Although counts are extremely important and are often used to trigger further investigation, they have limited use in epidemiology. In order to translate counts into information, the program manager must compare one count with another count. Unless the population sizes from which the counts came are the same, rates must be used for any comparison. To distinguish when to use a count or rate, the program manager must determine if the counts come from the same population size. If the population sizes are different, rates must be used. Hence, the most important use of counts is as a numerator or a denominator in a fraction that creates a rate. This allows the program manager to make comparisons by time, place, or person with other populations.

C-D-C Action 2: Divide

C-D-C ACTION 2: DIVIDE

Skill 2.	**The Ability to Calculate Ratios, Proportions, and Rates**

As soon as a program manager needs to make a comparison, the program manager must divide. Division is a routine skill that a program manager performs. Understanding the difference in definition, use, and the calculation of ratios, proportions, and rates is an essential skill of a program manager. This skill is critical because without dividing to create rates, the program manager is susceptible to social divisions caused by the unequal distribution of resources. The following definitions of ratios, proportions, and rates with examples will help the program manager with this task.

FIGURE 2.4
EPIDEMIOLOGICAL DEFINITION: NUMERATOR

NUMERATOR

Numerator = The upper portion of a fraction used to calculate a ratio, proportion, or rate.

$$\frac{\textbf{Numerator}}{\text{Denominator}} = \text{fraction}$$

From Figure 2.2: There were 70 newborn deaths in region A. Twenty (20) of the deaths were due to asphyxia. Both numbers might be used as numerators in a fraction, which could either be a rate, ratio, or proportion, as will be demonstrated in future examples.

The numerator is often the most easily obtained component of the fraction. But epidemiology is, in a way, the study of denominators. Identifying the appropriate denominator, the population at risk, is an important skill that the program manager/epidemiologist must develop.

FIGURE 2.5
EPIDEMIOLOGICAL DEFINITION: DENOMINATOR

DENOMINATOR

Denominator = The lower portion of a fraction used to calculate a rate or ratio. The population at risk for the event that is in the numerator in the calculation of a rate.

$$\frac{\textbf{Numerator}}{\text{Denominator}} = \text{fraction}$$

From Figure 2.2: There were 2,000 live births deaths in Region A and 4,000 in Region B. One fraction (20/2,000) is a rate. A second fraction (20/70) is a proportion. The differences between the fractions will be explained in the next few boxes. Understanding the differences and their uses is very important for the program manager.

Three types of fractions that are commonly used are ratios, proportions, and rates. The following figures highlight the definitions and ultimately their important differences that are summarized at the end of the section.

FIGURE 2.6
EPIDEMIOLOGICAL DEFINITION: RATIO

RATIO

Ratio: The value obtained by dividing one quantity by another, a fraction: a general term of which rate, proportion, percentage, prevalence, etc. are subsets.

From Figure 2.12: Any cell (a, b, c, d) divided by any marginal, or even by a number from outside the table, could be a ratio.

From Figure 2.2: Maternal mortality ratio (MMR)=

$$\frac{\text{Number of maternal deaths}}{\text{Number of live births}}$$

There were five maternal deaths in Region A and one in Region B. The MMR for Region A is 5/2,000 (expressed as either 25 per 10,000 or 250 per 100,000 live births).

(A discussion of the stability of this ratio is beyond the scope of the manual, but the program manager should be very cautious of using the MMR in the relatively small populations usually present in district-level programs.)

The numerator and the denominator of a ratio may be related or may be totally independent of one another. The numerator and denominator are usually not from same population when the term ratio is used. The exception to this is the important risk ratio, which is defined later in the section.

The important difference between a proportion and a ratio is that the numerator of a proportion is included in the population defined by the denominator, whereas this is not necessarily so for a ratio.

FIGURE 2.7
EPIDEMIOLOGICAL DEFINITION: PROPORTION

PROPORTION

Proportion: A type of ratio in which the numerator is included in the denominator.

From Figure 2.12: The fraction a / (a+c) would be the proportion of the outcome deaths due to the determinant. Note: The fraction a/(a+c+b+d) x 1,000 would also be a proportion, but it is defined as the rate of the outcome due to the determinant per 1,000.

From Figure 2.2: There are multiple proportions within the case study. The fraction 20/70 (28%) is the proportion of neonatal deaths due to asphyxia in Region A. The fraction 5/80 (6%) is the proportion of neonatal deaths due to asphyxia in Region B. Proportions are commonly expressed as percentages. The proportion of neonatal deaths is higher in Region B than in Region A; yet in the next section, the rate of asphyxiated deaths is higher in Region A than in Region B. It is the rate that is most important in this example.

Every rate is a proportion, but not every proportion is a rate. This is an important concept to understand. Program managers frequently use the "percentage of" something when comparing different situations. These comparisons are dangerous and should be avoided unless the proportion is a rate.

FIGURE 2.8
EPIDEMIOLOGICAL DEFINITIONS: RATE

RATE

Rate: A rate is a measure of the probability of the occurrence of a particular event

From Figure 2.12: Total outcome rate is equal to (a+c) / (a+b+c+d).
The determinant (risk factor) specific neonatal mortality rate is a/(a+b) x 1,000.
The non-determinant (risk factor) specific neonatal mortality rate is c/(c+d) x 1,000.

The row totals {(a+b) and (c+d)} are subpopulations of the total population. Since cells (a+ b) represent at least a subpopulation, the quantity a/(a+b) is a rate specific for the subpopulation with the determinant. A similar statement can be made for the non-determinant row.

From (Figure 2.2:
Region A:
Sixty (60) neonatal deaths/2,000 live births is the neonatal mortality rate (NMR). The NMR is expressed as 30 per 1,000 live births. There were 20 deaths were due to asphyxia. The NMR due to asphyxia is 20/2,000, or 10 per 1,000 live births.

Region B:
Eighty (80) neonatal deaths/4,000 is the neonatal mortality rate (NMR). The NMR is 80/4,000, or 20 per 1,000. There were 30 deaths due to asphyxia. The NMR due to asphyxia is 30/4,000, or 7.5 per 1,000.

Note: If the program manager had used the proportions calculated in the previous example to determine which region had a more significant problem with neonatal asphyxia, a wrong conclusion would have been drawn and possibly an incorrect action taken.

Part 2 HMIS

A rate is a ratio whose essential characteristic is that time is an element of the denominator. Also, there is a distinct relationship between the numerator and denominator in that all of the people in the denominator are at risk for the event in the numerator. The numerator is cases or deaths, and the denominator is the population at risk for the event. A condition of a rate is that time, place, and population must refer to the same period. The key to understanding the difference between rates, ratios, and proportions is the **denominator**(3)**.**

- Rate: the numerator is an event and the denominator is the population at risk for the event.
- Proportion: the numerator is from the same population as the denominator; but the denominator is not the total population at risk for the event in the numerator.
- Ratio: the numerator is from a population different from the denominator.

The key to calculating a rate is obtaining the denominator (the population at risk for the event in the numerator). However, in many settings without basic surveillance or good census data, the denominator is unknown and often has to be estimated. The most commonly used denominator in neonatal health is the number of live births. A simple method to estimate the number of live births for a given area is presented in Figure 2.9.

FIGURE 2.9
TECHNICAL TIP: ESTIMATING THE NUMBER OF LIVE BIRTHS

TECHNICAL TIP

$$\textbf{Estimated number of live births} = \frac{\textbf{estimated number of women aged 15- 45 years}}{\textbf{5}}$$

The number of women in an area aged 15-45 years can be estimated from the age structure of the country. In many developing countries, this will range from about 20-40 percent of the total population.

Example: A district has 1 million people, and 35 percent are women aged 15–45 years. Therefore, there are an estimated 350,000 women aged 15–45 years. The estimated number of births is 350,000 / 5 = 70,000. This number (70,000) could be used as the denominator.

Note: This is clearly an estimate to aid decision-making, and more accurate means to determine this denominator should be sought. Both the number of women and the denominator in this equation vary with a given situation.

The two major types of rates are incidence and prevalence. The term *incidence rate* refers to new cases of a given determinant/illness/disease in a population during a time period, so it estimates risk (i.e., STI incidence: new cases of STIs). *Prevalence* refers to all identified cases (new and old) at a given time (i.e., STI prevalence: new and existing case of STIs). Diseases that result in illnesses that last for a long time (i.e., TB) will have a higher prevalence (be more common) in the population than are diseases that have the same incidence rate but last for a shorter time period. A program manager needs to understand and use both incidence and prevalence rates(4).

FIGURE 2.10
EPIDEMIOLOGICAL DEFINITION: INCIDENCE AND PREVALENCE

INCIDENCE AND PREVALENCE	
	Incidence: The number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. More generally, the number of new events (i.e., new cases of a disease in a defined population) within a specified period. The term incidence is sometimes used to denote incidence rate. **Incidence rate:** A measure of the rate at which new events occur in the population. The number of new events (i.e., new cases of a specified disease diagnosed or reported during a defined period of time) is the numerator, and the number of persons in the stated population in which the cases occurred is the denominator. **Prevalence:** The number of instances of a given disease or other condition in a given population at a designated time. **Prevalence rate (ratio):** The total number of all individuals who have an attribute or disease at a particular time (or during a particular period) divided by the population at risk of having the attribute or disease at this time or midway through the period.

Many rates and proportions are used as indicators. Part Three, Step 4, describes a local indicator matrix that starts with a health outcome indicator, preferably a rate. Other indicators link the outcome indicators with interventions; sometimes this is a rate, but often it is a proportion. Process indicators for the interventions (related to the Five As - availability, accessibility, acceptability, affordability, and appropriateness) are linked to the managerial part of this system. These indicators trigger a response to a health or management problem, which can be addressed using quality management tools.

FIGURE 2.11
EPIDEMIOLOGICAL DEFINITION: INDICATOR

HEALTH INDICATOR	
	Indicator: A measurement that, when compared to either a standard or a desired level of achievement, provides information on a health outcome or management process. **From Figure 2.2:** Examples of indicators include neonatal mortality rate (NMR) and incidence of eclampsia. According to the data in Figure 2.2, the NMR for Region A is 35 and for Region B is 20. The incidence of eclampsia is 12.5 in Region A and 10 in Region B. By comparing indicators like these to a standard or desired level of achievement, the program manager can gain information that is useful for programming. Figure 2.15 provides an example of how this comparison is made.

Health indicators are necessary in order to analyze the current situation, make comparisons, and measure changes over time. Indicators can be absolute numbers, ratios, proportions, or rates. Rates are more useful as indicators because they are less susceptible to bias and misinterpretation. The need for these indicators is a common feature which will be discussed more in Section V[5].

C-D-C Action 3: Compare

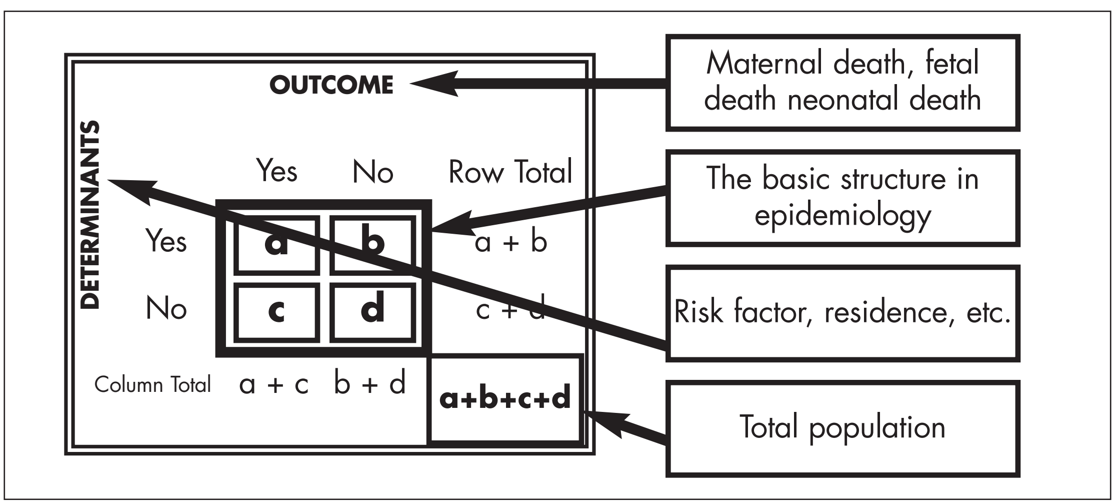
The synonyms for the word compare (contrast, evaluate, balance) take on a situational meaning that helps the program manager make decisions. The key to understanding how to translate data into information for intervention is to know when, what, and how to compare counts, ratios, proportions, and rates. Comparison of rates is the cornerstone of the gap analysis. The gap analysis is conducted by comparing differences between time periods, places, and population groups with use of outcome indicators to expose excess mortality and/or morbidity. This assists a program manager to identify opportunities to target the gaps with specific interventions. Section IV defines BABIES, which is a source of many rates derived from a simple two variable table whose columns are the age-at-death and whose rows are birth weight groups. The gap analysis starts with a comparison of BABIES by time, place, and person. The purpose of the gap analysis is to generate hypotheses that can focus attention on a health problem and its determinants, direct a program manager to the right intervention, and be used as the foundation of a local indicator system (described in Part Three). The local indicator system is absolutely necessary if quality services are to be developed and maintained at the community level.

C-D-C ACTION 3: COMPARE

Skill 3. The Ability to Understand and Use the 2 x 2 Table

The 2x2 table is a basic analytical structure in epidemiology (Figure 2.12) and the foundation of two-dimensional thinking.[6] It consists of two (2) rows and two (2) columns (hence the name 2x2 table) that have integrated two variables into four cells. Traditionally, the columns are the presence (yes or high) or absence (no or low) of an outcome, (i.e., mortality or morbidity). The rows are the presence (yes or high) or absence (no or low) of a determinant (i.e., risk factor, residence, etc.) of a person who is at risk for the outcome.

FIGURE 2.12
BASIC 2 X 2 TABLE



The cells a, b, c, and d are the counts (absolute numbers) that represent the number of people who have both the value for the outcome and for the determinant. The column and row totals (marginal cells) are the additions of the corresponding cells in the column and row. Rates, ratios, and proportions are defined by the way these different cells relate to one another as a numerator and denominator. Cells a, b, c, and d are used as either an absolute number or a numerator in a fraction, but they are never used as a denominator. Column and row totals can be used as either a numerator or denominator. The marginal used determines whether the measurement is a ratio, proportion, or rate. The most important denominator cell is the cell in the lower right-hand corner because it represents the total population.

TABLE 2.1
SUMMARY OF EPIDEMIOLOGICAL DEFINITIONS FROM 2X2 TABLE

TERM	EXAMPLE FROM FIGURE 2.12
Counts	Cells a, b, c, and d.
Numerator	Cells a, b, c, and d.
Denominator	Any marginal (the addition of any column or row in the 2x2 table) is a potential denominator(i.e., a+c, c+d, a+b+c+d).
Sup-population	Population with outcome: (a+c). Population without outcome: (b+d). Population with risk factor: (a+b). Population without the risk factor: (c+d).
Total population	a+b+c+d.
Ratio	Any cell (a, b, c, d) divided by any marginal, or even by a number from outside the table, could be a ratio.
Proportion	The fraction a / (a+c) would be the proportion of the outcome deaths due to the determinant. Note that the fraction a/(a+c+b+d) x 1,000 would also be a proportion, but it is defined as the rate of the outcome due to the determinant per 1,000.
Rate	Total outcome rate is equal to (a+c) / (a+b+c+d). The determinant (risk factor) specific mortality rate is a/(a+b) x 1,000. The non-determinant (risk factor) specific mortality rate is c/(c+d) x 1,000.
Incidence rates	a/(a+b)
Risk ratio (RR)	RR is defined as (a/(a+b))/ (c/(c+d)). This can be calculated mathematically by a(c+d)/c(a+b).
Attributable risk percent (AR%)	$AR\% = \frac{\{(a+b)/(a+b+c+d)x(RR-1)}{1 + \{(a+b)/(a+b+c+d)x(RR-1)} \times 100$

Part 2 HMIS

C-D-C ACTION 3: COMPARE

SKILL 4.	The Ability to Use a Rate, Ratio, or Proportion to Compare Populations

To evaluate a program, a program manager must use two things: a measurement and a comparison. Rates, ratios, and proportions are measurements, but the only measurement a program manager should use to compare is a rate (or a ratio of rates). Comparisons of non-rates, non-ratios or non-proportions are most often misleading, and even wrong. The following example reinforces the points made in the example being used throughout this section. It demonstrates some misleading conclusions resulting from using measurements other than rates.

FIGURE 2.13
WHY USE RATES?

Example: In area A, there are100 neonatal deaths, and 20 of the deaths are due to neonatal asphyxia. In area B, there are also 100 neonatal deaths, and five deaths are due to neonatal asphyxia.

- Conclusion 1: Area A has the same number of deaths as Area B (ratio 100/100=1).
- Conclusion 2: Area A has four times the number of deaths due to asphyxia compared to Area B (ratio 20/5=4).
- Conclusion 3: In Area A, 20 percent of the neonatal deaths are due to asphyxia, but it is 10 percent in Area B (proportion).

However, in Area A, there are 5,000 live births. In Area B, there are 2,000 live births. The neonatal mortality rate in Area A is 20 per 1,000(100/5,000). In Area B, it is 50 per 1,000 (100/2,000). The mortality rate due to asphyxia is 4 per 1,000 (20/5,000) in Area A, and 2.5 per 1,000 (5/2,000) in Area B.

Very different conclusions are drawn in this example when rates are used.
Message: Use rates!

Although beyond the scope of this manual, epidemiological concepts such as sensitivity, specificity, predictive values, and alpha and beta error can be more easily understood and used when one has a more complete understanding of the 2x2 table(7).

C-D-C ACTION 3: COMPARE

SKILL 5.	The Ability to Evaluate the Strength of a Risk Factor

The risk ratio enables a program manager to compare one determinant with another determinant to assess the strength of the association between the determinant and the outcome. Different determinants (risk factors) have stronger or weaker effects on the outcome. For example, a baby who is 35 weeks gestation at birth may have an eight-fold higher risk of dying than a baby who is born at term. The number eight was determined by calculating the ratio of the mortality rate in those who were 35 weeks gestation (numerator) with the mortality rate of those infants whose gestational age was 38 weeks (denominator).

$$\frac{\text{Neonatal mortality rate for babies born at 35 weeks}}{\text{Neonatal mortality rate for babies born at 38 weeks}}$$

Risk may also be dose related. For example, a baby born at 28 weeks would have a much higher risk of dying than the 35- week-gestation baby.

One risk factor may be associated with several diseases, such as a preterm birth being related to an increased probability of respiratory problems, asphyxia, jaundice, sepsis etc. Conversely, one outcome may be associated with a number of risk factors. For example, LBW is related to malaria, smoking, under-nutrition, etc. To prioritize different interventions to reduce LBW, the program manager needs to evaluate the strength of different risk factors.

If the data are based on new cases of the outcome collected prospectively, then it can assume that the risk ratio, or strength of the risk of the condition, is equivalent to the risk. If the data are based on a case control study, then the appropriate measure of risk is the odds ratio. In certain situations the odds ratio approximates the risk ratio, but a discussion of this is beyond the scope of this manual..

FIGURE 2.14
EPIDEMIOLOGICAL DEFINITION: RISK RATIO

RISK RATIOS

Risk ratio = The risk ratio or probability of the condition among those exposed to the risk factor (or treatment) compared to the risk of the condition in those not exposed. It is expressed as a ratio. The rate of those with the risk factor is the numerator and the rate of those without the risk factor is the denominator. The risk ratio requires prospectively collected data.

From Figure 2.12: The risk ratio is defined as: (a/(a+b))/ (c/(c+d)) This can be calculated mathematically by a(c+d)/c(a+b).

From Figure 2.2:
Region A:
The NMR for newborns born to mothers with eclampsia is 10/25, or 400 per 1,000. The NMR for newborns born to mothers without eclampsia is 60/1,975, or 30.4 per 1,000. The risk ratio of neonatal mortality for eclampsia is 400/30.4 = 13
Region B:
The NMR for newborns in born to mothers with eclampsia is 5/40, or 125 per 1,000. The NMR for newborns born to mothers without eclampsia is 75/3,960, or 18.9 per 1,000. The risk ratio of neonatal mortality for eclampsia is 125/18.9 = 7.

A program manager needs to compare newborns born in to mothers with eclampsia in Region A with those born in Region B. The risk ratio in this case is 400/125 =3.2. Women in Region A are 3.2 times more likely to develop eclampsia than the women in Region B. The program manager should investigate this inequity.

Odds ratio = odds of exposure among the cases, compared to the odds of exposure among the controls. The data come from case control studies and may approximate the risk ratio in certain situations.

In reality, most program managers will not carry out studies that provide data for the risk ratio and odds ratio calculations, but understanding the principles is for the decision-making process. More details on the formulas and how to calculate them are available on the attached CD-ROM. More important is that the program manager may use the risk ratio in the calculation of the attributable risk percent described in the next section.

C-D-C ACTION 3: COMPARE

SKILL 6. The Ability to Estimate the Impact of a Risk Factor on the Population (Attributable Risk Percent)

The attributable proportion, also known as the attributable risk percent, is a measure of the public health effect of a condition. Thus, the attributable proportion is the proportion of disease in an exposed group due (attributable) to the exposure. It represents the expected reduction in disease if the exposure could be removed (or never existed). In calculating this measure, we assume that the occurrence of disease in a group not exposed to the factor under study represents the baseline or expected risk for that disease. Any risk in the exposed group above that level will be attributed to their exposure.

FIGURE 2.15
EPIDEMIOLOGICAL DEFINITION: ATTRIBUTABLE RISK PERCENT

ATTRIBUTABLE RISK

Attributable risk percent $= \dfrac{\mathbf{f\,(RR - 1)\ \ x100}}{\mathbf{1 + f\,(RR\text{-}1)}}$

where risk ratio is equal to the risk ratio, and f is equal to the frequency of the risk factor in the population.

The attributable risk percent measures the effect of a given determinant on the health of a population. The effect depends on:

- the strength of the association of the determinant with the outcome, measured by the risk ratio; and
- how common the determinant is (the prevalence).

This means that a common determinant with a low risk of death may have more effect on the health of a population than a condition with a very high, but rare risk.

From Figure 2.12: Attributable Risk Percent =

$$\frac{\{(a+b)/(a+b+c+d)x(RR\text{-}1)\}}{1 + \{(a+b)/(a+b+c+d)x(RR\text{-}1)\}} \quad x100$$

From Figure 2.1:
The AR% for eclampsia in Region A is 13%.
The AR% for eclampsia in Region B is 5%.

Table 2.2 is the cornerstone for policy decisions from an epidemiological perspective[8]. It is also a good example of the two-dimensional thinking required of program managers. This table is a comparison of the different attributable risk percent achieved with different risk ratios and frequencies of a determinant. The different values of the risk ratio are the columns, and the values of the frequency of the determinant in the population are the rows.

For a given frequency (row), the attributable risk percent increases with increasing risk ratio. For a given risk ratio (column), the attributable risk percent increases with increasing frequency. Different strategies can be considered according to the different combinations of the risk ratio and frequency of the determinants. For example, in Table 2.2 the two highlighted cells represent two scenarios. In one scenario, 10 percent of the population has a determinant with a risk ratio of 4. The expected reduction in the mortality rate is 23 percent. In the next scenario, the frequency is 50 percent, but the risk ratio is 1.75. However, the attributable risk percent is 27 percent. The program manager will have to decide which strategy to choose on the basis of this difference and other factors discussed in later (Table 2.2).

TABLE 2.2
VARIATION IN ATTRIBUTABLE RISK
BY CHANGE IN RISK RATIO AND FREQUENCY OF DETERMINANT

Frequency (f) of Determinant	Risk Ratio (RR)					
	1.3	1.5	1.75	2	3	4
10%	3%	5%	7%	9%	17%	23%
20%	6%	9%	13%	17%	29%	38%
30%	8%	13%	18%	23%	38%	47%
40%	11%	17%	23%	29%	44%	55%
50%	13%	20%	27%	33%	50%	60%
60%	15%	23%	31%	38%	55%	64%
70%	17%	26%	34%	41%	58%	68%
80%	19%	29%	38%	44%	62%	71%
90%	21%	31%	40%	47%	64%	73%
100%	23%	33%	43%	50%	67%	75%

More Frequent Condition

More Serious Condition

A program manager might ask, *What if I do not have the risk ratio value or the frequency of the risk factor in the population?* At first, it would not be unreasonable to estimate their values. The program manager can consult with a clinical adviser or use the results of studies of similar situations. For an institution, such as a regional hospital, the risk ratio used could be that found in the facility, with the appropriate caution that should be observed in the use of facility-based populations. The ability to treat a condition successfully influences its risk ratio. Therefore, if the program manager is aware that within the setting the capacity to treat the condition is diminished or nonexistent, the risk ratio value could be placed in the range of 3-4.

With regard to frequency, program managers cannot manage the condition if the frequency is unknown. They need to establish a system that can give good counts. The frequency can also be estimated from the previous population surveys or patient load at the facilities with the risk factor - with the same caution regarding population versus facility-based profiles. Epidemiologists worry about the unknown bias, but a known bias can be handled through interpretation and stipulations. The program manager can make decisions regarding that factor in the reliability of the data.

Table 2.3 is a summary of the terms illustrated by using the basic 2x2 table (Figure 2.12).

TABLE 2.3
SUMMARY OF BASIC 2X2 TABLE
AND SELECTED DEFINITIONS FOR THE EXAMPLE IN FIGURE 2.2

General Principles

		NEONATAL DEATH +	NEONATAL DEATH -	TOTAL
ECLAMPSIA	+	**a**	**b**	a+b
ECLAMPSIA	-	**c**	**d**	c+d
TOTAL		a+c	b+d	a+b+c+d

Maternal death	n
Maternal death (eclampsia)	m

Count (neonatal deaths)	a, b, c, or d
Proportion ND (eclampsia)	a/(a+c)
Neonatal Mortality Rate	(a+c)/(a+b+c+d) x 1,000
Neonatal Mortality Rate (eclampsia)	a/(a+b) x 1,000
Neonatal Mortality Rate (no eclampsia)	c/(c+d) x 1,000
Incidence eclampsia	(a+b)/(a+b+c+d) x 1,000
Risk Ratio (eclampsia)	a/(a+b)/c/(c+d)
Attributable Risk Percemt (eclampsia)	{(a+b)/(a+b+c+d)/(RR-1)} 1+{(a+b)/(a+b+c+d)x(RR-1)
Maternal Mortality Rate	n/(a+b+c+d) x 100,000
Maternal Mortality Rate (eclampsia)	m/(a+b+c+d) x 100,000

Region A example: Region A had 2,000 live births in 2000. Of 70 neonatal deaths, 20 deaths were due to asphyxia, and 10 of the deaths were in 25 mothers with eclampsia. Three of five maternal deaths were due to eclampsia.

Region A

		NEONATAL DEATH +	NEONATAL DEATH -	TOTAL
ECLAMPSIA	+	**10**	**15**	25
ECLAMPSIA	-	**60**	**1,915**	1,975
TOTAL		70	1,930	2,000

Maternal death	5
Maternal death (eclampsia)	3

Count	70
Proportion ND (eclampsia)	14%
Neonatal Mortality Rate	35
Neonatal Mortality Rate (eclampsia)	400
Neonatal Mortality Rate (no eclampsia)	30.4
Incidence eclampsia	12.5
Risk Ratio (eclampsia)	13
Attributable Risk Percemt (eclampsia)	13%
Maternal Mortality Rate	250
Maternal Mortality Rate (eclampsia)	150

Region B example: Region B had 4,000 live births in 2000. Of 80 neonatal deaths, five deaths were due to asphyxia, and five of the deaths were in 40 mothers with eclampsia. There was one maternal death due to sepsis.

Region B

		NEONATAL DEATH +	NEONATAL DEATH -	TOTAL
ECLAMPSIA	+	**5**	**35**	40
ECLAMPSIA	-	**75**	**3,885**	3,960
TOTAL		80	3,920	4,000

Maternal deaths	2
Maternal death (eclampsia)	0

Count	80
Proportion ND (eclampsia)	6%
Neonatal Mortality Rate	20
Neonatal Mortality Rate (eclampsia)	125
Neonatal Mortality Rate (no eclampsia)	18.9
Incidence eclampsia	10
Risk Ratio (eclampsia)	7
Attributable Risk Percemt (eclampsia)	5%
Maternal Mortality Rate	50
Maternal Mortality Rate (eclampsia)	0

"Chance" as an explanation for the difference between Region A and Region B is assessed by performing statistical tests. Further explanation of this and a description of the statistical tests are beyond the scope of this manual. Further reading is accessible on the CD-ROM.

C-D-C ACTION 3: COMPARE

SKILL 7. The "Opportunity Gap" Described by Time, Person and Place

The excess morbidity and mortality for mothers and babies in the developing world is due to an inability to implement interventions already known to be effective for either preventing or treating the excess. Program managers need to respond to differences in morbidity and mortality between districts and sub-populations within districts.

FIGURE 2.16
EPIDEMIOLOGICAL DEFINITION: "OPPORTUNITY GAP"

OPPORTUNITY GAP	
	Gap: A gap, or excess, is a disparity between mortality or morbidity rates among populations or subpopulations. The gap represents a potential for reduction in excessive mortality based on a comparison between rates already achieved by one subpopulation in a defined geographical area with those experienced by the remaining population represents a program manager's objective. The difference in the rates represents an opportunity for the program manager to reduce the excessive mortality or morbidity, hence the "Opportunity Gap." **Example from Figure 2.2:** A gap analysis of the data for Region A and Region B reveals several health disparities. For example: 1. The NMR for Region A is 35. Region B has an NMR of 20. This produces a "gap" of 15 (35-20=15). 2. The NMR due to eclampsia is 400 in Region A and 125 in Region B. There is a "gap" in this health outcome of 275 (400-125=275). 3. Region A has an attributable risk of 13%. The attributable risk in Region B is 5%. The "gap" between these regions for attributable risk is 8% (13-5=8). It is the job of the program manager to determine why these gaps exist.

A more complete discussion of the "Opportunity Gap" is found in Section IV after the explanation of BABIES.

A common way to describe the "Opportunity Gap" in terms of time, place and person.

Time: Changes over time are important to describe health problems. Is the problem increasing, decreasing, or remaining the same? It is important to document changes in health status, population characteristics, access to resources, access to health services. Monitoring changes over time provides the means to determine whether populations are being adequately served.

Several aspects of time can be analyzed. Three are discussed in this section.

- **Age at death:** This information provides considerable insight as to the circumstances surrounding the event, particularly to what extent acute care services should have been provided to prevent or alter the outcome of the event.
- **Time of preventive intervention:** Acute care services that provided secondary prevention of mortality are usually more costly than preventive measures. It is important to analyze events with the idea of primary prevention. For example, preventing LBW newborns is less costly than taking care of LBW newborns.
- **Seasonal or day of the week occurrence:** Service loads and seasonal exposures can be evaluated when these aspects of time are considered.

Place: The characteristics of key events by residence status or place of occurrence are essential to epidemiological description. Once again several categories can be useful in this analysis:

- region, district or village;
- urban versus rural; and
- health institution versus home.

It is important to determine whether differences in geography (i.e., villages, districts) represent distinctive features of the political, economic, social, or health service environment. It is often important to aggregate the data into larger geographical units to gain insight into the relationship between the risk factors and outcome. This analysis can also suggest whether different types of interventions are needed in various geographical locations. Similar analyses can be conducted to assess the differences between rural and urban settings. For example, women and their families often utilize health services less in rural or peri-urban areas than in urban areas. Because most births and deaths occur at home, it is important to compare characteristics between the women who deliver at home and those who go to an institution. For example, a comparison of where the mother has her official residence versus where the event occurs may reveal whether the distance traveled to receive a service may result in an accessibility problem.

Person: Personal characteristics are fundamental to the description of the health of a population. Examples of personal characteristics include:

- age;
- sex;
- race;
- marital status;
- socioeconomic status; and
- behaviors.

Some personal characteristics cannot change, such as age, sex, and race. However, other characteristics can change over time such as education, income, health-seeking practices, and medical conditions. The most important information derived from the person analysis is the identification of "equity." For example, are teenage mothers less likely than older women to deliver with a skilled provider?

Profiles are combinations of personal characteristics that can be grouped together in a single variable with multiple categories. A common combination is race, maternal age, and education. For example, there are eight categories in the socio-demographic profile created by grouping each of the previous variables into two groups (race (Group A and Group B), maternal age (less than 20 and greater than or equal to 20 years), and maternal education (less than six and greater than or equal to 6 years of completed education).

TABLE 2.4
EXMAPLES OF PROFILE GROUPINGS

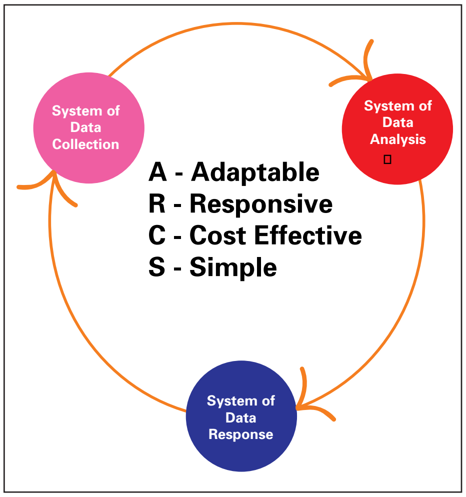
GROUP	RACE	MATERNAL AGE	MATERNAL EDUCATION
1	A	≥ 20 years	≤ 6 years
2	A	≥ 20 years	≥ 6 years
3	A	≤ 20 years	≤ 6 years
4	A	≤ 20 years	≥ 6 years
5	B	≥ 20 years	≤ 6 years
6	B	≥ 20 years	≥ 6 years
7	B	≤ 20 years	≤ 6 years
8	B	≤ 20 years	≥ 6 years

Other frequently used profile combinations include maternal age, parity, and birth interval as a family planning profile; medical conditions not related to pregnancy and medical conditions related to pregnancy. The latter can be combined with a contact variable (first contact, last contact, intrapartum contact) to provide a risk assessment combination for assessing the change in risk status throughout the pregnancy.

The ability to describe the "Opportunity Gap" in terms of time, place, and person provides the program manager with the insight necessary to generate hypotheses to explain the inequities observed in the population being served. This serves as the means to target specific interventions for specific populations while providing basic coverage for all.

III. BUILDING A HEALTH MANAGEMENT INFORMATION SYSTEM FOR HEWBORN HEALTH

FIGURE 2.17
ACTIONS AND ATTRIBUTES OF AN HMIS



An HMIS is a simple system that takes the most basic pieces of data and transforms them into valuable information that can easily be used for program decision-making. Although global indicators are pertinent to international policy, data collected by a local HMIS should be used first and foremost to guide local decisions.

> An HMIS is a *dynamic process* that enables one to collect, analyze, and respond to data about the occurrence and distribution of outcomes for a population within a given geographical location (Figure 2.17).

Several crucial points apply to a successful HMIS.

- Building an HMIS involves collecting selected pieces of data that are chosen because they can be transformed into information for decision-making about interventions.
- An HMIS is a dynamic system that needs to be reviewed constantly to maintain its relevance.
- An HMIS must involve key stakeholders, including the health care providers, the community, and other key decision-makers in a particular setting.
- An HMIS enables an ACTION to be taken on the basis of data, thereby allowing management by fact.

A. Translating Data into Information

Data are facts that are recorded. The collection of data is not valuable in itself-- data are valuable when they are transformed into information to make decisions about interventions to improve outcomes. Unfortunately, many data that are collected are never used for decision-making. Additionally, the existing data often reflect an underreporting of deaths, especially deaths among LBW babies who die in the late fetal and early neonatal periods, as outlined in Part One. Many barriers to collecting data on maternal, fetal, and neonatal deaths can be overcome. Nearly all countries collect some data on maternal and neonatal mortality, and existing data can be better used to identify or address maternal and neonatal problems. In Section IV, some tools - namely, BABIES - are provided to assist program managers in using these data.

> Data are records of facts or events and are often recorded as absolute numbers. Information is a "difference that makes a difference."

Information comes from data that have been organized in specific ways and compared to standards in order to empower decision-making. In the definition of a health problem, information is the difference between what is expected and what is observed. In the definition of a management problem, information is the difference between what is supposed to happen and what is actually happening.

Accounting for every pregnancy

Most data are available at the health center or hospital level, but most fetal-neonatal deaths throughout the developing world occur at home in the absence of skilled providers. Women who deliver at home often differ (i.e., in economic status, distance to the facility, and education) from those who seek services in a health care facility. Therefore, to obtain a complete picture of both maternal and fetal-neonatal mortality and their causes, it is important to account for all pregnant women and their deliveries.

> Every pregnancy counts……….
> so account for every pregnancy.

Accounting for every pregnancy does not entail a complicated, hi-tech approach, but it does, require a committed effort on the part of the formal and informal sectors of the HCDS.

Counting and weighing every newborn

Weighing every newborn does NOT imply a need for digital scales. Simple technology for weighing, such as a spring balance, is all that is needed for decision-making. Even in the absence of this equipment, broad classifications of normal and LBW are usually adequate to design programs that address the main newborn health problems. Once again, a commitment by the HCDS is needed to ensure that the recording of births and deaths is a priority.

> Every newborn counts and has a weight……….
> so count and weigh every newborn.

Characteristics of an HMIS

A system is more likely to function accurately if it supplies the people collecting the data with useful information. The essential attributes of such a system are that it is adaptable, responsive, cost-effective, and simple for the existing situation (Figure 2.7).

Adaptable: The system must be capable of being modified or adjusted readily to changes in the environment or meeting the requirements of a given situation.

Responsive: The system must answer the minimal questions that lead to alternative courses of action. It must be sensitive to change and specific enough to point out if new directions should be taken. Most important, it must meet the needs of the people who are collecting the data. Responsiveness implies relevance to each component of the HCDS.

Cost-effective: The system must be inexpensive in terms of physical resources and manpower, but at the same time effective. Efficiency is a primary objective from the very beginning of its design. An important lesson is to build on an already existing system. An old system with known deficiencies is better than a new system with unknown deficiencies. Rarely is there a need to totally dismantle a system and start over.

Simple: The system must be basic so that it is readily understood by all those who will be working with it. More complex systems can answer more sophisticated questions, but are more susceptible to malfunction. The HMIS only needs to raise a "red flag" indicating that further investigation is warranted. More sophisticated studies may be performed after the red flag is raised.

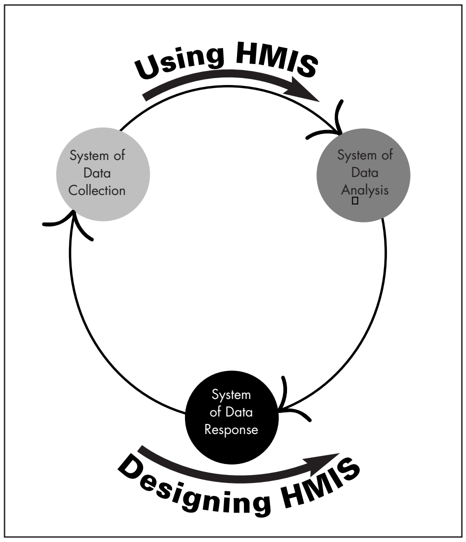
Various components of the HCDS have different roles in the HMIS (Table 2.5). Data collected at any level must be usable at that level. Data collected at the primary level can be passed on to the district or national level to provide aggregated data for programmatic review, but it should be used and understood at the level collected. Each component of the HCDS has an important role in the information system.

TABLE 2.5
SURVEILLANCE ROLES OF EACH COMPONENT IN THE HCDS

COMPONENT	COLLECTION	ANALYSIS	RESPONSE
Informal (community)	Participate in birth registration. Maintain home-based maternal record. Participate in focus groups and other participatory methods of data collection.	Participation in design and implementation of HMIS.	Take appropriate community action to respond.
Formal	Keep routine service statistics. Undertake special surveys, i.e., HIV prevalence. Contribute to vital registration system.	Analysis of service statistics and surveys.	Take appropriate action to resolve issues of service coverage or quality.
Intersectoral	Maintain vital registration system. Perform periodic census data collection.	Analyze data with respect to possible intersectoral action.	Promote supportive policy and solutions to identify problems.

B. Designing a Basic Health Management Information System (HMIS)

**FIGURE 2.18
USING AND DESIGNING
AN HMIS**



In many settings, data are collected on the basis of what can be collected, rather than what needs to be collected. The data that need to be collected are data that support important program decisions, or answer key management questions. The HMIS should enable the program managers and stakeholders to focus on the desired heath outcome and intervention results. A difference in the desired level of health outcome, or the desired results in the implementation of interventions, should be apparent, leading to appropriate decisions.

When designing an HMIS, program managers need to identify the key decisions they make, and what questions will need to be asked and answered to make those decisions. When the HMIS is used in the field the first action is data collection, the second is data analysis, and the third is a response (a clockwise rotation as seen in Figure 2.18). However, when designing an HMIS, the reverse order is used as discussed below.

1. **HMIS Action 1: Data response:** To which differences will the program manager respond? What decisions have to be taken regarding these differences? What information will help in these decisions? What questions need to be answered before a response can be made?

2. **HMIS Action 2: Data analysis:** What type of analysis is needed to provide the information necessary to make the decision?

3. **HMIS Action 3: Data collection:** What are the minimum data and the simplest way to collect these data that are needed to obtain the required information?

Therefore, the first action in designing the system is to determine the response required, the second action is to define how the data will be analyzed, and the third action is to describe data collection including processing and tabulation (a counter-clockwise rotation as seen in Figure 2. 18). This may seem like a subtle difference, but it is an important distinction. These actions allow the focus of the HMIS to be on the outcome. It results in a system that collects only the data required to measure the desired outcome and the process data related to the interventions. This method of HMIS design prevents project managers from obtaining large amounts of data without a clear link to the outcome.

HMIS ACTION 1 Data Response

Data are intended for use by decision-makers at all levels of the HCDS to plan, implement, and evaluate an organized response. At the local level, data are collected with a dual purpose. The health care worker collects data on an individual patient and uses it to manage the patient. The district health officer aggregates the same data to manage the local program. The aggregated district data are then passed up the chain of command for higher-level policy makers. Every level of the HCDS uses the data and should be expected to respond. When the data are appropriately analyzed and disseminated to decision-makers at each level, the HMIS can provide the ability to manage by fact. When programs are managed by fact, high-quality services can be delivered.

> Information is a powerful weapon
> to improve maternal, fetal, and neonatal health.

A system that collects data only but does not respond, or responds in an inappropriate way, does a disservice to the people who collected the data and ultimately to the people being served. Poorly operated systems result in unreliable data being collected, lack of interest on the part of the people collecting the data, and inappropriate decisions being made. The adage "garbage in, garbage out" applies. In contrast, when the appropriate feedback mechanisms are established, the quality of the data is increased, good decisions are made, and services prevent undesirable outcomes.

The most important consideration when developing a set of indicators is to define the expected response within each sector of the HCDS and also at each level of the formal health care system. For example, if neonatal tetanus cases are chosen as an indicator and the number of cases is above a defined target level, there should be action taken by (among others):

- the community (i.e., behavior change of traditional practices);
- the formal health care system locally (i.e., clean delivery standards);
- the public health authorities (i.e., improved support for tetanus toxoid immunization); and
- the intersectoral system (i.e., incorporating school girl tetanus toxoid immunization).

HMIS ACTION 2 | Data Analysis

The second component of the HMIS is an orderly arrangement and analysis of the data. Data should be processed in a timely manner to ensure their relevance. It is very important to strengthen the capabilities of communities and districts to analyze data and use them at the local level. Experienced personnel should analyze the data, but they should also participate in building the analytical capacity of each level of the HCDS. The data should be translated into information and presented in such a way that the options are easily understood at all levels. The main method of analysis should identify the "Opportunity Gap." This method, briefly described in the previous section and more completely defined in Section IV, compares observed results with expected results to determine which interventions should be emphasized. The expected results can be derived either from a standard in another country or from a subpopulation within the same country.

The steps to improve analysis at the local level include:

- a simple framework (such as BABIES) to facilitate assessment, intervention, and monitoring in the community;
- intervention/surveillance areas to provide prospective community-based surveillance with targeted interventions;
- using simple technology to record weight at birth and including this on birth certificates and client cards;
- strengthening the civil registration systems to improve coverage and quality of perinatal data; and
- using "tick" tables with multiple variables; tick tables have multiple dimensions that enable a single "tick" to be placed in a cell of the table and to represent more than one variable for a given person.

Specific objectives for the analysis depend upon the stage of the management cycle and on the questions that have been raised by the management cycle process. The analytical framework is more completely outlined in Section IV on BABIES. Familiarity with a computer statistical package is very helpful if more complex analyses are needed. The WHO/CDC package EPI INFO 2000 can be downloaded free from the Internet site given on the CD-ROM.

HMIS ACTION 3 | Data Collection

HMIS ACTION 3

TASK 3.1 | Define What Data to Collect

The data needed comes from conducting a process that identifies the intended response and the type of analysis required by a given situation. From experience, the minimum key data are listed in Table 2.6. The table also lists how the variables might be coded, the outcome information and possible analysis, and the possible response. In a given setting other relevant information, such as prevalence of malaria or syphilis in pregnant women, will be needed.

HMIS ACTION 3

TASK 3.2 Determine Where and How to Collect the Data

Quantitative data give a general idea of the magnitude of a problem, but qualitative data usually help to understand the whys. Therefore, it is necessary to collect both qualitative and quantitative data to fully understand the situation and select the most effective interventions for that context.

Quantitative data collection can include gross indicators of health status (i.e., maternal mortality rate, infant mortality rate, total fertility rate, contraceptive prevalence rate, and service coverage rates). They also reflect the availability and accessibility of the health infrastructure (i.e., available equipment, health facilities per population, use of facilities). Data collection instruments may include structured record review, structured interviews with clients, and health facility assessments. Instruments to be used in the communities may consist of Knowledge, Attitude, and Practice (KAP) surveys or some adaptation. These tools are characterized by closed-ended questions. There are many surveys available (i.e., Demographic and Health Survey (DHS) module on maternal mortality, WHO Health Facility Assessment, American College Nurse Midwives (ACNM) Assessment) that have been tested and can be adapted.

Qualitative data collection includes beliefs and practices about pregnancy, delivery, postpartum care, newborn care, the community perception of health facilities and staff, and the decision-making processes for access to care for mothers and babies. Instruments to collect qualitative data include focus groups, participatory approaches, and verbal autopsies. Focus groups are guided discussion groups that provide more in-depth information on many topics, particularly about beliefs, perceptions, and issues that affect quality of care. Such groups are useful to further explore trends seen in the quantitative data to better understand them. Participatory approaches, such as participatory rural appraisals (PRA) or participatory learning in action (PLA) are other alternative collection forms for qualitative data. Typically, PRA and PLA involve community groups (i.e., men, women, elders, providers) to collect diverse information. Because data are collected from several sources, it is important to triangulate them (cross-reference through the use of different tools that enable the collection of the same data in different ways) to ensure their validity. A variety of tools (i.e., village mapping, reproductive life cycling) can be used to assist the community in describing their situation and beliefs. The aim of these approaches is to enhance the learning of all the participants.

TABLE 2.6
EXAMPLE OF ESSENTIAL DATA TO COLLECT FOR A MINIMUM DATA SET FOR NEWBORN HEALTH IN A GENERAL HMIS

DATA TO COLLECT	CODING OF VARIABLE	OUTCOME INFORMATION AND POSSIBLE ANALYSIS	POSSIBLE RESPONSE TO DATA AT POPULATION LEVEL
Maternal age.	Years old at last birthday.	Perinatal mortality rate (PMR), still-birth rate (SBR), neonatal mortality rate (NMR), analysis by age.	Address unmet need for family planning delay/space/prevent pregnancy.
Residence.	Urban, rural.	PMR, SBR, NMR analysis by place.	Address gaps in outcome by area.
Obstetrical history.	Normal, abnormal.	PMR, SBR, NMR analysis by obstetric history.	Are women with abnormal previous history getting good care now?
Place of delivery.	Home, health center, hospital.	Home delivery rate. Institutional delivery rate. Mortality by place of delivery.	If many deaths are occurring at home, why is this? Lack of access or quality?
Attendant at birth.	Untrained/trained TBA, midwife, doctor.	Coverage with skilled attendant at birth.	Increase coverage of skilled attendant. If high coverage, increase quality
Mode of delivery.	Vaginal, C-section, other operative.	Method of delivery rate. C-section rate.	Assess unmet need for emergency obstetrical care (if C-section is <5%, this is too low).
Date of birth.	mm/dd/yr	Analysis by time of LBW rate of fetal/neonatal deaths or of service coverage.	Are outcomes improving with time? If not why not?
Birth weight.	VLBW (<1500 g). IBW (1500-2499 g). NBW (>2,500 g).	VLBW rate, IBW rate. BW specific mortality rates. Birth weight by age at death analysis (BABIES).	Maternal health strategies, (FP, nutrition, female literacy) intersectoral action.
Sex.	Male, female.	Sex-specific PMR, NMR.	Policy and educational support to reduce gender preference, selection.
Plurality.	Singleton, multiple.	PMR, SBR, NMR by plurality.	Are multiple pregnancies receiving appropriate care and experiencing good outcomes?
Gestational age.	In weeks by last menstrual period. Premature (less than 37), Mature(37-42), Postmature (more than 42).	Preterm birth rate. Rate of IUGR in term babies.	Interventions to reduce LBW addressing preterm birth or IUGR or both.
Breastfeeding in the first hour.	Yes, no.	Rate of early breastfeeding.	Improve policy and support of early breastfeeding.
Exclusive breast-feeding at 1 month.	Yes, no.	Rate of exclusive breastfeeding at 1 month.	Improve policy and support of exclusive breastfeeding.
Cause of death	Cause, i.e., sepsis, asphyxia, tetanus, birth defect.	Cause by birth weight, place of delivery, age.	Address specific causes for certain populations.
Birth outcome.	Alive, stillbirth (fresh, macerated).	BABIES is described in the next chapter. Birth weight specific mortality rates.	Birth weight mortality rates are used to make major decisions about the choice of intervention and the quality of the intervention being implemented.
Age at death.	Weeks of gestation or Days after birth.		

HMIS ACTION 3

TASK 3.3 Define the Types of Data

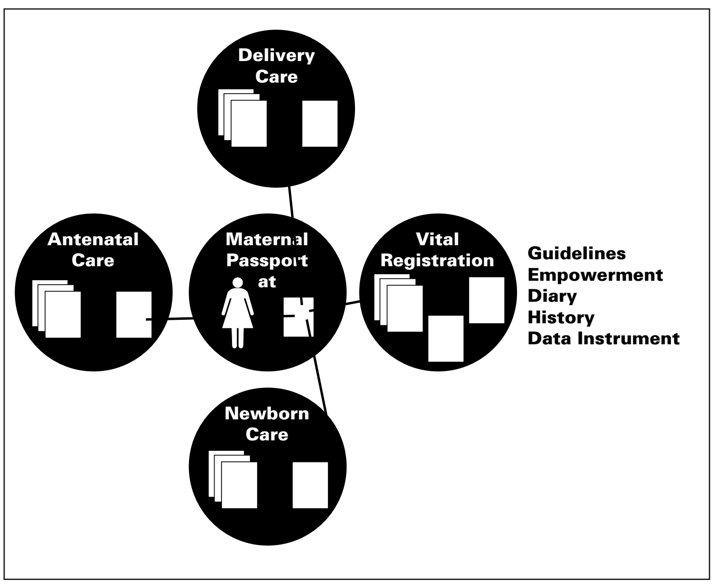
Given that these deaths most often happen at home, it is essential to collect data from the community. Hospital-based surveys significantly underestimate the problem and are not able to capture many of the barriers to care that occur outside of the health institution. Maternal and neonatal deaths are not solely a medical problem, and so it is important to collect data from many different perspectives to be able to identify barriers to maternal health services. Both quantitative and qualitative data can be collected in the community as well as in health institutions.

There are numerous methods for regular collection of quantitative data about outcomes for the mother and the baby. However, the most suitable for low-resource settings are:

- a home-based maternal record/newborn record;
- a community-monitoring board;
- birth registers in institutions/health centers; and
- verbal autopsies and case reviews.

Quantitative data can be collected with various tools at the health institution. This approach is more appropriate to one or two stages of the management cycle than to ongoing surveillance tools. This is due to the selection bias that is usually associated with institutional-based systems.

FIGURE 2.19
THE MATERNAL RECORD

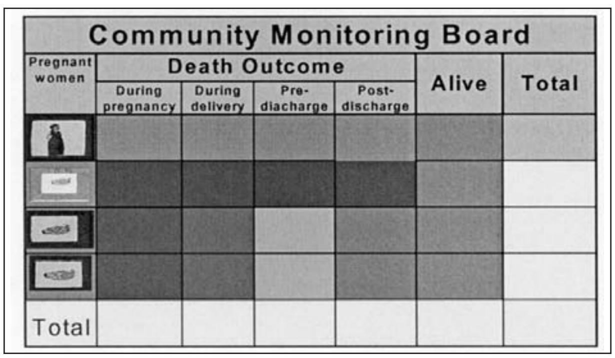


The Home-based maternal/newborn record (the "maternal passport") has been supported by WHO. It is a home-based, maternal/newborn, 1- to 2-page record that the mother keeps. Each time she has contact with the HCDS her progress is updated (i.e., results of screening tests, problem lists, and treatment records during the course of pregnancy, labor, delivery, and the postpartum period). A copy of this record may be maintained at the local health facility and can serve as the means for data collection. The essential newborn data to be collected are birth weight, sex, date of birth, place of delivery, mode of delivery, attendant, gestational age (if known), plurality, residence, breastfeeding-at-7-days, and age-at-death for a live birth, or for a fetal death whether the stillbirth was macerated or fresh (Table 2.6). The essential maternal data include maternal age, obstetrical history, medical complications, treatments received during pregnancy, and family planning methods.

The importance of this record should not be underestimated. Continuous communication and feedback between the various levels of care are needed to ensure that the health system response is appropriate and of sufficient quality. Performance of regular case reviews of maternal, fetal, and neonatal deaths and "near misses" is an effective means of identifying substandard care and avoidable factors. Institution of a home-based maternal record is an effective means of achieving better client management. The home-based maternal care record can serve five main functions (Figure 2.19) to:

- communicate the essential care practices and serve as a guideline for care providers;
- empower the mother and her spouse, family, and community to expect a standard of care from the HCDS;
- serve as a clinical record (enabling communication between providers at various levels of care) and to monitor progress during pregnancy, childbirth, and the postpartum period;
- serve as a historical document for future reference and care; and
- serve as a data collection instrument for the HMIS in monitoring and evaluating maternal and perinatal services.

FIGURE 2.20
THE COMMUNITY MONITORING BOARD USED IN RURAL TANZANIA



The community monitoring board is a means of tracking every pregnancy and its outcome in the village (Figure 2.20). The rows represent the different birth weight groups of the newborn. For each pregnant woman, a pin that is first located in the upper left green cell will be moved to the appropriate cell upon delivery. The columns stand for the status (alive or dead) of the mother and newborn. In Tanzania, the board has also been used as a visual representation of the BABIES matrix, which is more fully described in the next chapter. Community leaders can assess their situation by reviewing where the pins are placed on their board and can act according to the intervention cells on the board.

Birth registers (delivery room logs) are kept in most institutions in which deliveries occur as either a birth register or delivery room log. The delivery room log is a line listing of every event that takes place in the delivery room. An untapped wealth of data on births and deaths is kept in these delivery room logs, but these data often go unnoticed and, consequently, underutilized. Variables such as maternal age, parity, residence, medical conditions, mode of delivery, attendant, length of labor, birth weight, and sex of the newborn, as well as outcome for both the mother and newborn, are included in the delivery room log.

The delivery room log tick table is an appropriate technology for low resource settings. Data processing and analysis are greatly facilitated by the computer, but the lack of a computer should not prevent relatively sophisticated analysis of the delivery room log[11].

Figure 2.21 is a typical delivery room log. Figure 2.22 is a representation of a typical, but abbreviated delivery room log line listing (the columns have been narrowed to simplify illustration). The rows of the delivery room log correspond to data from one woman, and the average number of women per double page is 20. Traditionally, the delivery room head midwife hand tallies the data with simple frequencies by making several passes through the pages of the delivery room log. The numbers of C-sections, LBW babies (expressed as percentages), and maternal deaths, stillbirths, and pre-discharge neonatal deaths are common elements in the monthly report. The other data in the delivery room log may be used to manage the patient, but usually goes unused for programmatic purposes.

FIGURE 2.21
PICTURE OF A DELIVERY ROOM LOG BOOK

FIGURE 2.22
ABBREVIATED LINE LISTING OF DELIVERY ROOM LOG BOOK

# Ser.	RC#	Age (Yr)	Gravidity	Parity	BthInterval	GA @ Reg	# Antenatal Visits	Method of delivery	Place of delivery	Type of delivery	Risk @ Registration	Risk status@ Delivery	Hgb < 9	Outcome	Birthweight	Sex	Age at death	Cause of death
ID																		

Consider an alternative method that uses a "tick table." A tick table is a multi-dimensional table containing 2 to 6 variables in which each combination of all of the variables has one cell. For example, a table with 2 variables and 2 values for each variable will have 4 (2x2) cells. A table with 3 variables and 2 values for each variable will have 8 (2x2x2) cells. For each person in a line listing with the variables there is one cell that describes all combinations of the values of each variable. Health personnel using tick tables simply proceed through the table in an orderly fashion that brings them to the cell that describes a person in the line listing with each value of the variable. A tick is placed in the cell or a dot filled for every person with those values.

Figure 2.23 is an example of a tick table used by health personnel in Africa. The core table is the outcome of the mother and baby (columns) and the birth weight group of the baby (rows). In the next section, this core table is defined as BABIES. In Figure 2.23, the mother and baby are classified according to complications at delivery (defined locally but might include prolonged labor, pre-eclampsia and eclampsia, diabetes, hemorrhage, etc.), the attendant of the delivery (physician or midwife), and the mode of delivery (vaginal or c-section). Instead of several passes through the delivery room log book to count the frequency of one variable, the midwife makes only one pass. The midwife performs the following tasks for each line (woman).

Part 2 HMIS

FIGURE 2.23
DELIVERY ROOM LOG TICK TABLE

Delivery Room Log Tick Table

Labor Complications, Attendant at delivery, Type of delivery, Birthweight group				Mother			Baby					
				Alive	Dead	Total	Alive	Stillbirth		Neonatal Death		Total
								Late Fetal	Intra Partum	Early NND < 7 days	Late NND 7- <28 days	
Labor complications	Physician	Vaginal	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo oooooooooo	oo		oooooooooo oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
		C-sec	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
	Midwife	Vaginal	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
		C-sec	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
No complications	Physician	Vaginal	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo oooooooooo	oo		oooooooooo oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
		C-sec	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
	Midwife	Vaginal	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
		C-sec	<1500	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			1500-2499	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			2500-3999	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
			4000+	oooooooooo	oo		oooooooooo	oo	oo	oo	oo	
	Column Total											

Task 1 | Task 2 | Task 3 | Task 4 | Task 5 | Task 6 | Task 7

- ✤ **Task 1.** She determines if the mother experienced a complication(s), a condition(s) previously defined according to the available delivery room log book data. She chooses the appropriate group of rows.
- ✤ **Task 2.** She determines who delivered the mother and baby and chooses the appropriate group of rows.
- ✤ **Task 3.** She determines the type of delivery (vaginal or C-section) and chooses the appropriate group of rows.
- ✤ **Task 4.** She determines the birth weight of the baby and chooses the corresponding row in which the value falls.
- ✤ **Task 5.** She places a tick in the circle of the appropriate outcome column for the mother.
- ✤ **Task 6.** She places a tick in the circle of the appropriate outcome column for the baby.
- ✤ **Task 7.** She adds the columns and rows of the table.

Upon completion of this monthly task the midwife has a table that provides her with the traditional frequencies in the monthly report. She can provide:

- the percent of births to women with labor complications;
- the percent of births covered by a physician;
- the c-section rate;
- the low birth weight rate;
- the fetal and neonatal mortality rates; and
- the number of maternal deaths.

These are all proportions that are available from the frequency counts taken from the delivery room log book.

In Section IV, the manual presents BABIES, the core table in this example. The same data will produce much more information because of the way it has been organized with BABIES.

Verbal autopsies and case reviews can be done in the institutions or in the community. Because most maternal and newborn deaths occur at home, this type of approach is very important for delving into issues related to the delays in obtaining medical care, such as identifying the problem, deciding to seek care, and obtaining transportation.

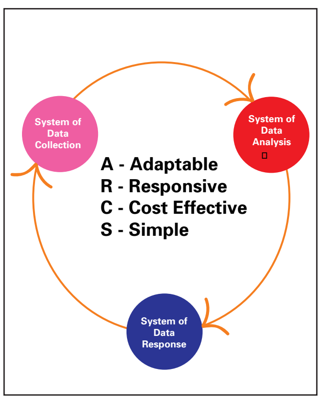
SUMMARY
BUILDING AN HMIS

Information is a powerful weapon to reduce disparity in maternal and newborn health outcomes.

Data translated into information can raise a "red flag" signalling areas that may require further investigation or action.

An HMIS is a dynamic system that can be used to collect, analyze, and respond to data about the occurrence and distribution of outcomes for a population within a given geographical location.

Every pregnancy counts.....................so account for every pregnancy.
Every newborn counts and has weight…so account for and weigh every newborn.



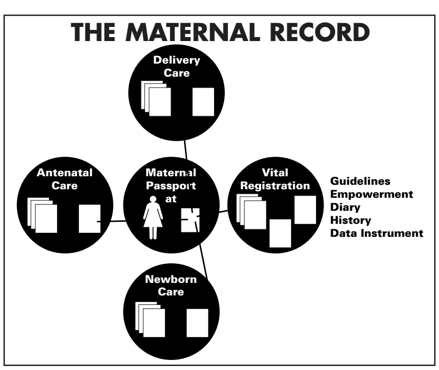
An HMIS should be adaptable, responsive, cost-effective, and simple to operate. Each level of the HCDS has a responsibility in the operation of the system and should be able to use the data it collects to make level-appropriate decisions.

An HMIS has three parts: data collection, data analysis, and data response. When it is functioning, the system operates in a clockwise fashion. When designing, a counterclockwise process should be used.

The important questions that need to be asked when designing the system are grouped according to the three HMIS components.

1. **HMIS Action 1: Data response:** To which differences will the program manager respond? What decisions have to be taken regarding these differences? What information will help in these decisions? What questions need to be answered before a response can be made?

2. **HMIS Action 2: Data analysis:** What type of analysis is needed to provide the information necessary to make the decision?



3. **HMIS Action 3: Data collection:** What are the minimum data and the simplest way to collect these data that are needed to obtain the required information?

The maternal record is a core element in the system. It serves as a guideline for what is supposed to happen, an empowerment tool for the mother to know and demand what should happen, a diary of the current pregnancy, a history recorder for the future, and a data collection tool for surveillance.

IV. THE BIRTH WEIGHT AND AGE-AT-DEATH BOXES FOR AN INTERVENTION AND EVALUATION SYSTEM MATRIX

FIGURE 2.24
BABIES MATRIX

B BIRTH WEIGHT GROUP &
A AGE AT DEATH
B BOXES for an
I INTERVENTION &
E EVALUATION
S SYSTEM

BABIES Matrix is an adaptable assessment tool that allows the program manager to collect, organize, analyze, and translate data into information for newborn health intervention. It combines two pieces of data:

- age at the time of death of the fetus/newborn
- birth weight group

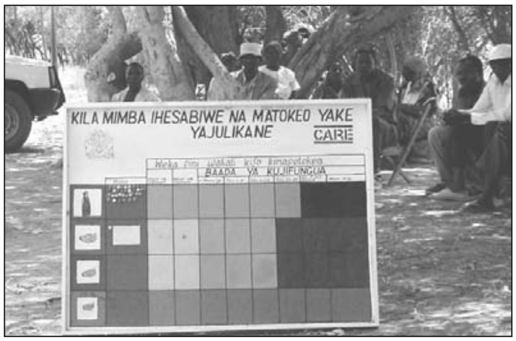
BABIES is a simple system to define the newborn health problem, assess the performance of the HCDS, select effective interventions, and perform monitoring and evaluation.

A. Uses of the BABIES Matrix

The BABIES Matrix can be used for tracking all pregnancies at levels of the health care delivery system ranging from the village to peripheral health institutions and hospitals. At the district or regional level, BABIES can help the program manager to identify "Opportunity Gaps in their setting. These “gaps” are identified by making comparisons by time, place, and person. These comparisons enable managers to make important decisions regarding policy, the choice of interventions, training, and resource allocations (Panel 2.1).

PANEL 2.1
LESSON LEARNED

COMMUNITY MONITORING BOARD AS A TOOL TO PRIORITIZE INTERVENTIONS



As part of a CARE's community-based reproductive health project in rural Tanzania, a Maternal and Perinatal Health Care Surveillance System was established to monitor pregnancy outcomes. Village health workers were trained to collect data during health education visits to pregnant and postpartum women. Information on sociodemographics, medical history, delivery characteristics, and pregnancy outcome was collected. Maternal and fetal/infant survival or deaths were tracked on a community monitoring board, organized by birth weight and age-at-death, and grouped according to underlying causes and associated potential interventions. Among 904 pregnancies, the fetal-neonatal mortality rate was 69.4 deaths per 1,000 total births. There were four maternal deaths. The low birth weight rate was 19 percent. Intrapartum and early neonatal deaths with birth weights less than 1,500 grams represented a large proportion of deaths, most of which occurred among deliveries at home or at dispensaries, the most basic level of care.
These preliminary results will be used to prioritize project interventions, including increasing access to skilled delivery care. Ongoing data collection will provide outcome indicators for project evaluation.

Source: Unpublished data, CARE/CDC Health Initiative Project in Mwanza, Tanzania (2000)

B. Concepts for Understanding BABIES

Five concepts are listed in Table 2.7 and discussed in this section to help the program manager understand and use the BABIES tool more effectively.

TABLE 2.7
BABIES CONCEPTS

Concept 1	Time: age at death of fetus /neonate
Concept 2	Birth-weight group or birth size of fetus /neonate
Concept 3	Think in two dimensions – the birth weight and time at death matrix
Concept 4	Interpreting the cells in BABIES and grouping them into intervention packages
Concept 5	The Opportunity Gap

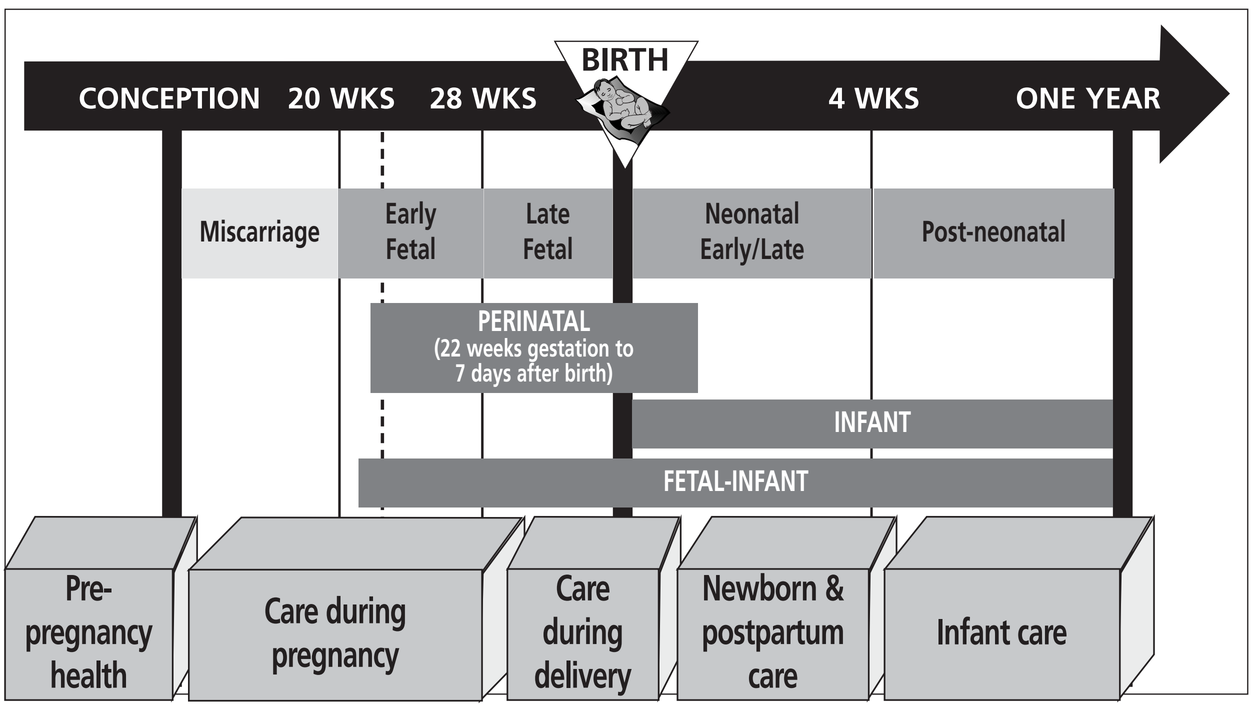
CONCEPT 1. Time (age at death of fetus/neonate)

Traditionally, program managers have thought in one dimension, time. Maternal and newborn programs have focused on providing interventions based on their effect during specific periods (Figure 2.25). Key periods when interventions are packaged together to have a major impact on the health of the mother and newborn include:

- pre-pregnancy;
- during pregnancy;
- during delivery;
- postpartum/newborn period; and
- infancy.

Time periods form the columns in the BABIES matrix and can be used for both mother and baby death events.

FIGURE 2.25
INTERVENTION PACKAGE FOR TIME PERIODS OF PREGNANCY, NEONATAL AND INFANT LIFE



Part 2 HMIS

CONCEPT 2. Birth-Weight Group or Birth Size

Birth weight is one of the best predictors of neonatal survival. The distribution of birth weight within a given population is often a reflection of the general health status of pregnant women. A healthy mother is the first requirement for a healthy newborn. The growth of the fetus, as measured by birth weight, is primarily related to maternal factors such as age, parity and spacing of pregnancies, nutrition, infections, and workload. Strategies for improving outcomes for the baby can be divided into two categories: those aimed at altering birth weight distribution and those aimed at improving the survival of babies already born. The suggested birth weight groups for BABIES are those which correspond to the level of technology required to substantially improve the chance of neonatal survival. Very low birth-weight (VLBW, 0-1,499 grams) newborns require a high level of expensive technology, usually far above the capacity of developing countries. The intermediate birth weight (IBW, 1,500-2,499 grams) newborn requires a moderate level of technology, mostly associated with temperature control, feeding, and treatment for infections. The normal birth weight (NBW, ≥2,500 grams) newborn requires the least technology and benefits most from a skilled attendant who makes the proper decisions.

CONCEPT 3. Think in Two Dimensions - The Time and Birth Weight Matrix

The BABIES matrix is created by cross-tabulating age of death categories (columns) and birth weight groups (rows) to form a matrix. The simplest cross-tabulation has two columns and two rows. As in the Count-Divide-Compare (C-D-C) cycle, the cells contain the absolute count of deaths. In many settings, the quantity and the quality of data are incomplete and poor. The tool, however, is flexible. Even if crude birth weight groups are used, they will provide useful information for decision-making . For example, in a setting where most newborns are not weighed, their relative size (small versus normal) may be used for the rows (the title of the rows in the matrix in Table 2.8). The setting allows one to distinguish between stillbirths (deaths before or during labor) and live births (deaths after labor and delivery). At the village or institutional level, the absolute count of deaths organized in this way provides a wealth of information.

As discussed in Figure 2.12, a simple 2x2 table can be used to organize the data as presented in Table 2.8. If the data are available, the rows and columns can be refined to include smaller groupings of birth weight and age at death. In this manual, a basic 12-cell matrix is used (Figure 2.24). In more developed settings, the rows can be divided further to include less than 1000 grams and 4000+ grams groups. In institutional settings, the time periods are frequently divided into hours and days. This flexibility is one of the advantages of the BABIES matrix.

TABLE 2.8
READING THE BABIES MATRIX

BIRTH WEIGHT GROUP	**STILLBIRTHS** (deaths before or during labor)	**DEATHS TO LIVE BIRTHS** (up to specified age)
Small	Cell 1 If a death is placed in this cell, the baby is in the small birth-weight group **AND** was a stillbirth.	Cell 2 If a death is placed in this cell, the baby is in the small birth-weight group **AND** was born alive but died before a given age.
Normal	Cell 3 If a death is placed in this cell, the baby is in the normal birth-weight group **AND** was a stillbirth.	Cell 4 If a death is placed in this cell, the baby is in the normal birth-weight group **AND** was born alive but died before a given age.

In Figure 2.24, there are four time periods that will be used for age at death.

1. **During pregnancy:** 28 weeks gestation until the onset of labor.
2. **During delivery:** from the onset of labor to birth.
3. **Pre-discharge:** In a health institution, this is the time before the newborn leaves the facility. In the home, this is the time before the attendant leaves the home.
4. **Post-discharge:** from discharge to the 28th day of life.

There are three birth-weight group:

1. **Very low birth weight (VLBW):** (less than 1,500 grams).
2. **Intermediate birth weight (IBW):** (1,500-2,499 grams).
3. **Normal birth weight (NBW):** (at least 2,500 grams).

FIGURE 2.26
THE 12-CELL BABIES MATRIX

	During Pregnancy	During Delivery	Predischarge	Post Discharge
≤1,499g	1	2	3	4
1,500-2,499g	5	6	7	8
≥2,500g	9	10	11	12

Since there are four values for age at death and three values for birth weight group, the cross-tabulation of age at death and birth weight group has 12 (3x4) cells in the table.

At the village or institutional level, the deaths are counts. Each death (count) is plotted in the appropriate cell. A cluster of deaths in a particular cell is a visual representation of a problem in a particular birth weight group and time period. Villagers or staff members react to the cluster. In settings where only the 12 cells were used as a community monitoring board, the visual reminder was a "death" table and viewed as a negative reminder. In order to put a more positive perspective on the board, the villagers using the community monitoring board in Tanzania added another column for the "alive" mothers and infants (Panel 2.1).

The addition of the "alive" column actually facilitates the next step in the C-D-C cycle. In order to divide, the cells in the rows and columns are added to produce the totals of the matrix. The totals of the rows and columns are the denominators to calculate rates, ratios, and proportions. A cell, or group of cells, divided by a total (either row total or column total) produces a rate or proportion that can be used as an indicator. The program manager uses the indicators derived from the BABIES matrix to make comparisons for monitoring and evaluation. This information derived from the comparisons allows the program manager to make important decisions or answer key questions about the program.

FIGURE 2.27
BABIES MATRIX
COUNT-DIVIDE-COMPARE

	During Pregnancy	During Delivery	Predischarge	Post Discharge	Alive	Total
≤1,499g	1	2	3	4	17	18
1,500-2,499g	5	6	7	8	18	20
≥2,500g	9	10	11	12	21	22
Total	13	14	15	16	23	24

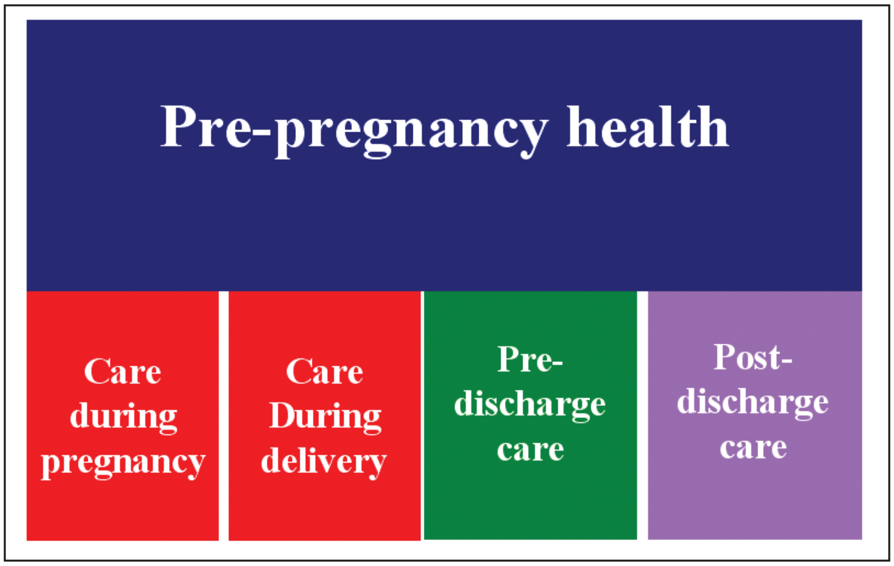
In Figure 2.7, cells 17, 19, and 21 contain the total number of newborns who are alive (survivors) at 28 days. Cells 18, 20, and 22 are the row totals for the respective birth weight groups, both deaths and live newborn. Cells 13,14,15, and 16 are the column totals for the number of deaths in each period. Cell 24 is the total number of events (stillbirths plus live births). Different rates with various uses will be described. later in this section These rates, their use, and interpretation will vary primarily according to which cell is used as the denominator. Cell 24 will be used most frequently as the denominator, but cells 18, 20, and 22 also have important uses as denominators. The column totals, cells 13 through 16, are the most frequently used cells used in the numerator when calculating the traditional mortality rates.

To fully utilize the BABIES matrix, the program managers should make a sincere effort to know the outcome of every pregnancy (total births). At the village level, and definitely at the institutional level, this is not as difficult as one imagines. The community monitoring board and genuine community participation greatly facilitates this task.

CONCEPT 4. Intrepreting the Cells in BABIES and Grouping Them into Intervention Packages

Table 2.9 helps to interpret each of the cells in the BABIES matrix. Examples of the common causes of death are given in each of the cells in the second column.

FIGURE 2.28
GROUPING THE CELLS IN BABIES BY INTERVENTION PACKAGE



On the basis of knowledge of the intervention packages, the cells can be grouped into major intervention categories. In Figure 2.28, the grouped cells are color-coded into the four generic categories: the third column in Table 2.9 names the Intervention Package. These intervention packages will be described in greater detail in Part Four including:

- Pre-pregnancy health (blue cells, cells 1 to 4);
- Care during pregnancy (red cells, cells 5 and 9);
- Care during delivery (dark red cells, cells 6 and 10);
- Pre-discharge care (green cells, cells 7 and 11); and
- Post-discharge care (magenta cells 8 and 12).

TABLE 2.9
INTERPRETING THE BABIES TOOL

CELL	WHAT THE CELL MEANS	EXAMPLES OF COMMON CAUSES OF DEATH FOR THIS CELL	INTERVENTION PACKAGE
1	Deaths (stillbirths) before the onset of labor among babies weighing less than 1,500 grams.	Maternal infection and other causes of preterm labor. Severe antepartum hemorrhage. Hypertensive disease in pregnancy. Maternal syphilis.	Pre-pregnancy health
2	Deaths (stillbirths) during labor among babies weighing less than 1,500 grams.	Maternal infection and other causes of preterm labor. Severe antepartum hemorrhage. Hypertensive disease in pregnancy.	Pre-pregnancy health
3	Deaths among live births before they are discharged from the health institution[1] among babies weighing less than 1,500 grams.	Complications of prematurity, such as surfactant deficiency, asphyxia, jaundice, and infection.	Pre-pregnancy health and high-tech neonatal care
4	Deaths among live births after they are discharged from the health institution among babies weighing less than 1,500 grams.	Later complications of prematurity, such as infections, feeding failure, jaundice.	Pre-pregnancy health and simple newborn care
5	Deaths (stillbirths) before the onset of labor among babies weighing between 1,500-2,499 grams (macerated stillbirth).	Maternal syphilis and other sexually transmitted infections (STIs). Hypertensive disease in pregnancy.	Care during pregnancy
6	Deaths (stillbirths) during labor among babies weighing between 1,500-2,499 grams (fresh stillbirth).	Asphyxia due to intrapartum obstetric emergency.	Care during delivery
7	Deaths among live births before they are discharged from the health institution among babies weighing between 1,500-2,499 grams.	Complications of prematurity and intrauterine growth restriction (IUGR), including infections, asphyxia, jaundice, hypothermia, hypoglycemia. Severe birth defects.	Newborn care
8	Deaths among live births after they are discharged from the institution among babies weighing between 1,500-2,499 grams.	Neonatal sepsis, neonatal tetanus, jaundice. Birth defects.	Newborn care
9	Deaths (stillbirths) before labor among babies weighing more than 2,500 grams (macerated stillbirth).	Maternal syphilis and other STIs. Hypertensive disease in pregnancy, malaria.	Care during pregnancy
10	Deaths (stillbirths) during labor among babies weighing more than 2,500 grams (fresh stillbirth).	Asphyxia due to intrapartum obstetric emergency.	Care during delivery
11	Deaths among live births before they are discharged from the health institution among babies weighing more than 2,500 grams.	Asphyxia and birth trauma. Infections, especially sepsis. Jaundice. Severe birth defects.	Newborn care
12	Deaths among live births after they are discharged from the health institution among babies weighing more than 2,500 grams.	Infections, especially sepsis, tetanus. Jaundice. Birth defects.	Newborn care

[1] If the baby was not born in an institution, this column can be interpreted to mean until the skilled attendant leaves the home. If most deliveries are unattended, the matrix can be adapted. For example, use age (first 24 hours or first week) for this column.

Pre-pregnancy health(cells 1 to 4): Excessive numbers of newborn deaths recorded in cells 1 through 4 reflect the health of the mother (Table 2.9). Most babies with birth weight less than l,500 grams are preterm with intrauterine growth retardation (IUGR). Both prematurity and IUGR are related to the health status of the mother, primarily to nutrition, infections, high parity, or pregnancy at a young age as described in Part One. Cells 1 and 2 record babies who weigh less than 1,500 grams and are stillborn. This outcome may be due to any cause of preterm birth, including infections, such as malaria or bacterial vaginosis, or obstetric emergencies, such as antepartum hemorrhage or cervical incompetence. Therefore, the interventions that may be the most effective in improving outcome are primarily targeted at the mother. These include:

- family planning;
- assessment, referral, and treatment for pre-existing medical conditions (i.e., hypertension, diabetes, malaria);
- improving nutrition/micronutrients/ maternal energy conservation;
- preventing, identifying, and treating infections especially STIs in the 1st and 2nd trimester; and
- avoidance of substance abuse, such as smoking, alcohol, and other drugs.

Care during pregnancy (cells 5 and 9): These deaths are usually macerated still-births. Recording an excessive number of fetal deaths among neonates weighing greater than or equal to 1,500 grams occurring in cells 5 and 9 reflects the health of the mother during the pregnancy period (not including early abortions). Fetal deaths occurring before the onset of labor reflect poor care during pregnancy and are most often due to maternal syphilis or diabetes. The difference between a macerated and fresh stillbirth indicates whether the late trimester care was less than optimal (macerated stillbirth) or whether the labor and delivery services needed improvement (fresh stillbirth). Major interventions during this period include:

- adequate quality of antenatal care, including complications of pregnancy such as antepartum hemorrhage, gestational diabetes, and hypertensive disorders of pregnancy;
- improved nutrition during pregnancy including micronutrients;
- addressing anemia in pregnancy, including malaria treatment were appropriate;
- prevention, identification, and treatment of infections, especially STIs; and
- birth planning for all women, especially those who are HIV positive.

Care during delivery (cells 6 and 10): Recording an excessive number of fetal-newborn deaths among neonates weighing greater than or equal to 1,500 g in cells 6 and 10 reflects the care of the mother during labor and delivery. These deaths are the best indicator of a poorly functioning emergency obstetric care system and may mirror "near misses" of maternal deaths. The primary interventions in this situation include:

- good coverage with skilled attendant at birth;
- adequate quality of emergency obstetric care services (surgical and medical services to treat sepsis, eclampsia, hemorrhage, obstructed labor);
- adequate quality of immediate newborn services (resuscitation); and
- functioning transportation and communication systems to reduce delays in access to care for the mother /newborn.

Pre-discharge: early newborn care (cells 7 and 11): An excessive number of early deaths among neonates weighing greater than or equal to 1,500 g reflects the system's institutional capacity to care for the newborn. Deaths recorded in these cells are often due to an inability to resuscitate the newborn, maintain thermal control, or treat infections. These are easier to prevent with a moderate level of technology. Deaths recorded in these cells usually occur in the health institution from one hour after delivery until 2 -3 days of life. Interventions include:

- extra newborn care to prevent complications;
- adequate quality of newborn resuscitation;
- medical services to treat sepsis, asphyxia, jaundice, and metabolic conditions; and
- functioning transportation and communication systems to reduce delays in access.

Post-discharge: late newborn care (cells 8 and 12): An excessive number of later deaths among neonates weighing greater than or equal to 1,500 g reflects the care of healthy newborns after they leave the health institutions. Deaths in the time period of 4 to 12 days of life should alert the program manager to cases of neonatal tetanus or neonatal sepsis, which may be related to cord care practices. If the newborn is not exclusively breastfed, the excessive deaths may be due to diarrhea after exposure to unsafe water in the formula. If the newborn is exclusively breastfed, acute respiratory infection may be the primary cause of death. Gender-specific differences in these cells also provide an early warning of preferential care being given to one gender.

The outcome indicators derived from BABIES can and should be linked to indicators associated with intervention packages. Each group of cells has an evidenced-based package that, if implemented, should reduce deaths in those cells. The interventions within the package have an "impact" indicator that provides information about the intervention. For example, in Figure 2.28, if an excessive number of deaths are recorded in the blue cells (pre-pregnancy health), the impact of contraceptive prevalence, anemia rate, and smoking rate are important indicators to monitor.

CONCEPT 5. The “Opportunity Gap”

This completes the Count-Divide-Compare cycle. The comparison of rates (mortality and/or morbidity) between a selected standard population and the local population defines a "gap"in health status. If the selected population has achieved a better health status than the local population, this comparison provides an opportunity for the local population to improve their health status. There is an “opportunity” to achieve fairness between populations by improving the availability, accessibility, acceptability, affordability, and the appropriateness (the Five As) of services to marginalized groups in order to reduce the “gap.” In many situations, a large portion of the “Opportunity Gap” may be concentrated in one subpopulation (i.e., LBW babies, adolescent mothers) or with one specific cause (i.e., infection). One overall objective of the program is to reduce the “Opportunity Gap.”

Part 2 HMIS

PANEL 2.2
LESSON LEARNED

THE "OPPORTUNITY GAP" STEP-BY-STEP USING BABIES IN CALI, COLOMBIA

From 1997-2001, health officials in Cali, Colombia, collected data on fetal and neonatal deaths from the University Hospital, the only public, tertiary level hospital in the city. Because the data were collected at the institutional level, only newborn deaths occurring before discharge from the hospital were captured.

TABLE 2.10a
MORTALITY AND EVENT DATA FOR THE REMAINING POPULATION (EXCLUDING THE STANDARD POPOULATION)BY AGE AT DEATH AND BIRTH WEIGHT GROUP

	CARE DURING PREGNANCY	CARE DURING DELIVERY	NEWBORN CARE	ALIVE	TOTAL
≤1500	193	55	53	801	1102
1500-2499	116	26	18	4898	5058
≥2500	149	46	27	22645	22867
Total	458	127	98	28344	29027

Task 1: The raw data were plotted into the BABIES matrix for the population of interest, and excluded the standard population from Cali to be used in calculating the "Opportunity Gap" (Table 2.10.a). The age at death categories corresponded to the time of the intervention package: care during pregnancy, care during delivery, and newborn care prior to discharge. Birth weight was divided into three categories: ≤1,500 g, 1,500-2,499 g, and ≥ 2,500 g, Babies alive at discharge were included in the matrix.

TABLE 2.10b
BIRTH WEIGHT PROPORTIONATE MORTALITY RATES (EXCLUDING STANDARD POPULATION) AGE AT DEATH AND BIRTH WEIGHT GROUP

	CARE DURING PREGNANCY	CARE DURING DELIVERY	NEWBORN CARE	TOTAL
≤1500	6.6	1.9	1.8	10.4
1500-2499	4.0	0.9	0.6	5.5
≥2500	5.1	1.6	0.9	7.6
Total	15.8	4.4	3.4	23.5

Task 2: With the plotted data in the BABIES matrix, birth weight proportionate mortality rates were calculated for the population (Table 2.10.b). To calculate this rate, the number in each cell was divided by the total number of events (29,027) and multiplied by 1,000. For example, the rate for death care during pregnancy for less than 1500g weight group was 6.6 per 100 (193/29027 x 1000). After converting the raw data, the rates were plotted in the BABIES matrix.

PANEL 2.2
LESSON LEARNED

THE "OPPORTUNITY GAP" STEP-BY-STEP USING BABIES IN CALI, COLOMBIA (CONT.)

TABLE 2.10c
BIRTH WEIGHT PROPORTIONATE MORTALITY RATES (LOCAL STANDARD) BY AGE AT DEATH AND BIRTH WEIGHT GROUP

	CARE DURING PREGNANCY	CARE DURING DELIVERY	NEWBORN CARE	TOTAL
≤1500	2.0	1.0	0.0	3.0
1500-2499	3.0	0.0	0.0	3.0
≥2500	5.0	1.5	0.5	7.0
Total	10.0	2.5	0.5	13.0

Task 3: Officials in Cali chose a local group as the standard to calculate the Opportunity Gap. This standard consisted of women who were <35 years of age, literate, with no previous pregnancies, and more than three prenatal visits. The raw data for the standard group were plotted into the BABIES matrix and then converted into birth weight proportionate mortality rates (Table 2.10c).

TABLE 2.10d
BIRTH WEIGHT PROPORTIONATE MORTALITY RATES BY INTERVENTION PACKAGE

<table>
<tr><td></td><td colspan="3">Local Population</td></tr>
<tr><td>≤1500</td><td colspan="3">10.3 (6.6+1.9+1.8=10.3)</td></tr>
<tr><td>1500-2499</td><td rowspan="2">9.1</td><td rowspan="2">2.5</td><td rowspan="2">1.5</td></tr>
<tr><td>≥2500</td></tr>
<tr><td></td><td colspan="3">Standard</td></tr>
<tr><td>≤1500</td><td colspan="3">3.0</td></tr>
<tr><td>1500-2499</td><td rowspan="2">8.0</td><td rowspan="2">1.5</td><td rowspan="2">0.5</td></tr>
<tr><td>≥2500</td></tr>
<tr><td></td><td colspan="3">"Opportunity gaps"</td></tr>
<tr><td>≤1500</td><td colspan="3">7.3 (10.3-3.0=7.3)</td></tr>
<tr><td>1500-2499</td><td rowspan="2">1.1</td><td rowspan="2">1.0</td><td rowspan="2">1.0</td></tr>
<tr><td>≥2500</td></tr>
</table>

Task 4: Before assessing the "Opportunity Gap", the birth weight proportionate mortality rate for each intervention package was calculated. For example, to obtain the sample mortality rate for the Pre-Pregnancy Health intervention package, the three rates within the less than 1500g group were added (6.6+1.9+1.8=10.3). This process was performed on the local data and local standard for each intervention package. Using these matrices, officials in Cali calculated the "Opportunity Gap" for each intervention package (pre-pregnancy, care during pregnancy, care during delivery, newborn care) by subtracting the standard rates from the sample rates (Table 2.10d). For example, the gap in the pre-pregnancy health rate was 7.3 (10.3-3.0=7.3). This finding indicated that the package with the greatest potential for the reduction in fetal and newborn mortality was the Pre-Pregnancy Health package. Consequently, the Columbian health officials decided to concentrate their public health efforts there.

Part 2 HMIS

C. Using BABIES to Program for Newborn Health

Program managers can adapt the actions to implement the BABIES matrix to fit their situation (Table 2.11). Each of these actions is briefly described in this section. Examples, lessons from the field, and reference tables are used to clarify some of the actions.

TABLE 2.11
ACTIONS FOR IMPLEMENTING THE BABIES MATRIX

Action 1	Review data and adapt the matrix to the program setting.
Action 2	Plot the data into the matrix.
Action 3	Convert raw data into rates.
Action 4	Calculate the "Opportunity Gap."
Action 5	Analyze the "Opportunity Gap" by time, person, place.
Action 6	Choose the cell or group of cells upon which to focus.
Action 7	Assess performance with regard to the chosen focus cell.
Action 8	Choose the intervention strategy and establish goals and objectives.
Action 9	Select outcome and process indicators for your program and develop HMIS.
Action 10	Repeat the cycle to achieve continuous improvement.

BABIES ACTION 1. Review Data and Adapt the Matrix to the Program Setting

The basic 12-cell table is well-suited for village use. The choice of rows (birth weight groups) and columns (age at death) is very flexible. The rows can be adapted to emphasize big babies or small babies, depending on where mortality is the biggest problem. The choice of columns for a given setting depends on two factors:

- where the deliveries take place (mainly at home or in institutions); and
- how much follow-up care is feasible.

Home deliveries may provide an opportunity for longer follow-up periods because the village health worker may be more available. Because institutional deliveries may have short stays and little follow-up, the time column may need to be divided into hours rather than days. After the BABIES matrix is created (selecting the rows and columns on the basis of the data available), the data can be plotted in the cells.

BABIES ACTION 2. Plot the Data Into the Matrix

Plot the data from the village, health center, and hospital in the BABIES matrix. The deaths are placed in the appropriate cells. The delivery room log is an untapped data source that often has a line listing for every delivery and usually contains many of the personal characteristics that help define subpopulations for describing the "Opportunity Gap". In a matter of hours, institutions with thousands of births per year can construct the BABIES matrix, even adapting the columns for more specific time periods or sorting the populations to compare each BABIES matrix.

The BABIES matrix provides a better understanding of both the population the institution serves and how well the institution performs. Table 2.12 provides an example of what the raw data (deaths) might look like from a district hospital. A case review of the deaths provides additional data for the development of the intervention strategy. The review should start with all maternal deaths and all deaths among normal-size babies.

TABLE 2.12
BABIES: AN EXAMPLE USING RAW NUMBERS

BIRTH WEIGHT GROUPS	DURING PREGNANCY	DURING DELIVERY	PRE-DISCHARGE	POST - DISCHARGE
<1,500 g	**14** *Cell 1*	**12** *Cell 2*	**24** *Cell 3*	**11** *Cell 4*
1,500-2,499 g	**11** *Cell 5*	**9** *Cell 6*	**41** *Cell 7*	**22** *Cell 8*
>2,500 g	**38** *Cell 9*	**30** *Cell 10*	**39** *Cell 11*	**8** *Cell 12*

The following information can be derived from Table 2.12.

- Cell 9 contains numerous macerated stillbirths, suggesting the presence of maternal conditions or infections that were not appropriately treated in the last trimester.

- Cells10 contains fresh stillbirths that occurred during labor, suggesting a problem with labor monitoring and/or an inability to react to acute conditions during labor. This is most disturbing because these stillbirths may also indicate "near miss" maternal deaths, particularly if the mother is ill at the time of delivery.

- Cells 3, 7, and 11 are live births, but the babies died before they left the hospital (pre-discharge). This is high among all the birth-weight groups, but particularly among the normal birth weight group and suggests a problem with asphyxia that may be related to cell 10.

- Cells 4, 8, and 12 are live births who went home, returned to the facility, and died in the hospital. Importantly, in a real setting underreporting of these deaths on an institutional basis is likely.

Remember, these are absolute numbers. These numbers need to be converted into a rate before appropriate comparisons can be made.

FIGURE 2.29
CALCULATING RATES FOR BABIES
EXAMPLE: RATE OF DEATHS DURING DELIVERY (CELLS 6 AND 10)

	During Pregnancy	During Delivery	Pre-discharge	Post Discharge	Alive	Total
≤ 1500g	Cell 1 14	Cell 2 12	Cell 3 24	Cell 4 11	Cell 17 15	Cell 18 76
1500-2499g	Cell 5 11	Cell 6 9	Cell 7 41	Cell 8 22	Cell 19 250	Cell 20 333
≥ 2500g	Cell 9 38	Cell 10 30	Cell 11 39	Cell 12 8	Cell 19 4025	Cell 22 4140
Total	Cell 13 63	Cell 14 51	Cell 15 104	Cell 16 41	Cell 23 4290	Cell 24 4549

Cell 6 9 Cell 10 30	Divided by	Cell 24 4549

(9 + 30)/ 4549 x 1000 = 8.5 per 1000 total births

The expected rate for these cells is 0.2/1000 from Table 2.13. Therefore the "Opportunity Gap" compared to the Canadian standard is 8.8-0.2= 8.6 per 1000. The rate present in this population is 44 times higher than the rate experienced by the Canadian population.

Task 1: Place all the deaths and the live births in the appropriate cells by birth weight and age at death.

Task 2: Add the totals for each row to fill cells 18, 20, 22.
Add the totals for each column to fill cells 13, 14, 15, 16, 23.
Add the totals for all the rows and columns (cell 24).

Task 3: Add the deaths in cells 6 and 10 to give the totals during delivery to infants weighing greater than or equal to 1500 grams. Use this as the numerator in the fraction.

Task 4: Divide the total in cells 6 and 10 by cell 24 (denominator). Multiple the number by 1000 and express as a rate of deaths per 1000 during delivery for babies weighing greater than or equal to 15000 grams.

BABIES ACTION 3. Convert Raw Data into Rates

There are several components to this step:

- ✤ Add each cell in a row for a row total (birth-weight groups, cells 18, 20, 22 of Figure 2.29);
- ✤ Add each cell in a column for a column total (age at death, cells 13, 14, 15, 16);
- ✤ Add the total rows and columns (totals events, stillbirths, and live births, cell 24);
- ✤ Select the numerator; and
- ✤ Select the denominator.

Follow the steps in Figure 2.29 to calculate the rate of deaths during delivery (cells 6 and 10). Table 2.13 contains the definitions of several rates that can be calculated from the BABIES matrix. The first column contains a shaded replica of the color-coded matrix. The cells involved in the rate calculation still have their numbers. The calculation description is in the third column. For example, the first rate described is the Birth weight Proportionate Fetal-Neonatal Mortality Rate for the maternal health cells. It is calculated by adding cells 1, 2, 3, and 4 together as the numerator, dividing by cell 24 as the denominator, and multiplying by 1,000. It is expressed as a rate per 1,000 total births.

TABLE 2.13
SELECTED MORTALITY RATES DERIVED FROM BABIES THAT ARE USEFUL FOR PROGRAM

	Calculation to get result based on Figure 2.24	
Description of result	**Cell**	
Total fetal deaths	Cell 1+5+9+2+6+10 or 13+14	
Total neonatal deaths	Cell 3+4+7+8+11+12	
Total fetal pre-discharge deaths among VLBW infants	Cell 1+2+3	
Total fetal pre-discharge deaths among IBW infants	Cell 5+6+7	
Total fetal pre-discharge deaths among NBW infants	Cell 9+10+11	
Total fetal deaths in the during pregnancy period	Cell 1+5+9	
Total fetal deaths in the during delivery period	Cell 2+6+10	
Total neonatal deaths in the pre-discharge period	Cell 3+7+11	
Total neonatal/postneonatal deaths in the post-discharge period	Cell 4+8+12	
Birth weight proportionate mortality rate	Numerator	Denominator
Pre- pregnancy health fetal-infant mortality rate	Cell 1+ 2+ 3+ 4	Cell 24
Care during pregnancy fetal-neonatal mortality rate	Cell 5 +9	Cell 24
Care during delivery fetal-neonatal mortality rate	Cell 6 +10	Cell 24
Pre-discharge care fetal-neonatal mortality rate	Cell 7 +11	Cell 24
Post-discharge care fetal-infant mortality rate	Cell 8 +12	Cell 24
Birth weight specific (BWS) rate mortality rate	Any cell 1-12	The appropriate denominator
BWS feto-infant mortality rate for < 1500g	Cell 1+2+3+4	Cell 18
BWS feto-infant mortality rate for 1500-2499g	Cell 5+6+7+8	Cell 20
BWS feto-infant mortality rate for > 2500g	Cell 9+10+11+12	Cell 22
BWS antepartum fetal mortality rate for > 2500g	Cell 9	Cell 22
BWS inrapartum fetal mortality rate for > 2500g	Cell 10	Cell 22
BWS pre-discharge mortality rate for > 2500g	Cell 11	Cell 22
BWS post-discharge mortality rate for > 2500g	Cell 12	Cell 22

BABIES ACTION 4. Calculate the "Opportunity Gap"

Action 4 has two tasks. The first component is the selection of a standard (or comparison group). The second component is calculation of the gap in terms of time, place, person, and cause of death.

Task 1: Select a standard

A problem is a disparity between the way something is and the way you want it to be. Program managers need to compare the data from their situation with that from another, more desirable one. The discomfort associated with the results of the comparison will determine the degree to which their situation is perceived as a problem.

> **The infant mortality rate in a district is 75 per 1,000 live births. Unless a standard is used for comparison, a problem cannot be defined. If Sweden's NMR of 3 per 1,000 live births is used as the standard, the Opportunity Gap is 72 (75-3). If data from the capital city of the country shows that that IMR is 50 per 1,000 live births, then the Opportunity Gap is at least 25 (75-50). The degree to which this gap causes discomfort determines how much of a problem it is.**

There are three possible comparison populations: an external standard, a national standard, or an internal subpopulation standard drawn from the manager's geographical area. Each is described below and their relative merits are compared in Table 2.14. The underlying question, particularly for the internal standard, is, If one subpopulation has already achieved an acceptable level of mortality, why can't the others achieve it?

External standard: This standard is most often available, usually coming from a more developed country. Such a standard can be used to describe the equity gap between countries. Objections to its use are based on the inequities in resources between developed and the less-developed countries.

National standard: This standard is usually the most acceptable because it fulfills national identity requirements. It often represents data from a more advantaged socioeconomic region in the country, which can make the gap someone else's problem among the more powerful political groups. The national standard can be used to identify the equity gap within a country.

Internal subpopulation standard: This standard is probably the most appropriate to use, but is the most difficult to develop. It requires data from a specific group, but the advantages in using these data during the analysis outweigh the difficulty in obtaining them.

TABLE 2.14
CHOICES OF A STANDARD POPULATION BY WHICH TO DEFINE THE "OPPORTUNITY GAP"

	EXTERNAL STANDARD	NATIONAL STANDARD	INTERNAL STANDARD
Strengths	Data most readily available, usually from a developed country. Describes the equity gap between countries.	Usually most acceptable (from within the same country). Can be used to identify the equity gap within a country.	May be the most appropriate. May be the best means of identifying high-risk populations requiring intervention.
Limitations	Objections to using this standard are based on the inequities in resources between countries (thus, unattainable goals).	Usually represents data from socioeconomically advantaged populations in the country (thus, may not be accepted by other groups).	Limited availability of data. Program manager may not have the skills or resources to collect these data.

Table 2.14 contains the fetal-infant birth weight proportionate mortality rates from two selected populations in developed countries. The stillbirth data available from the state of Connecticut in the United States could not be stratified into the care during pregnancy and care during delivery groups. The Nova Scotia data allow the comparison of care during pregnancy and care during delivery rates because they can be grouped according to the recommended time periods. Although these two situations have the same feto-infant mortality rate, comparison suggests that different intervention strategies are needed for further reductions in the rate. The majority of the excessive mortality in Nova Scotia is during pregnancy (1.6 per 1000), whereas in Connecticut the major problem is the pre-pregnancy health period (2.3 per 1000).

TABLE 2.15
BIRTH WEIGHT PROPORTIONATE FETAL-INFANT MORTALITY RATES THAT CAN BE USED FOR STANDARD COMPARISONS WHEN CALCULATING THE "OPPORTUNITY GAP"

	Nova Scotia, Canada (1999)	Connecticut, U.S.A. (1996)
Pre-pregnancy health	1.3	2.3
Care during pregnancy	1.6	0.7*
Care during delivery	0.2	
Newborn care	1.3	1.0
Infant care	0.5	0.9
Total fetal-infant	4.9	4.9
Profile	White women Married >20 years of age	White women >13 years of education >20 years of age
Data source	Nova Scotia Reproductive Health Program	National Center for Health Statistics Birth-Death Linked Infant Mortality tapes

*Category combined due to a lack of differentiation at the time of data collection.

Task 2: Calculate the "Opportunity Gap"

The mortality rate for each cell in the basic 12-cell table can be compared with the same cell in the chosen standard. The difference in the mortality rate for each cell is the "Opportunity Gap." Grouping the cells into the Intervention Packages described earlier is a more efficient way to make the comparison. By comparing the rate in each package, the opportunity for intervention is more clearly defined. For example, if the Pre-Pregnancy Health Intervention Package cells have a rate of 1 per 1,000, and the local rate is 10 per 1000, there is a significant gap. This can direct your questions further to identify the cause of this gap.

BABIES exercise:

Table 2.16 contains six different population-based BABIES matrixes. Rates for each of the Intervention Packages were calculated in the manner described in Figure 2.27. All of the cases are real and were chosen because of the completeness of the reporting. Cases 1 and 2 represent two subpopulations from a developed country within the same geographic region. Case 3 is from an urban setting in a developing country with a wide range of mortality rates, including some areas with fetal-infant mortality rates similar to those of Case 6. Case 4 is from an urban setting in South America. Case 5 is for a population in a Middle Eastern country. Case 6 is from sub-Sahara Africa.

Part 2 HMIS

TABLE 2.16
BIRTH WEIGHT PROPORTIONATE MORTALITY RATES FOR GROUPED INTERVENTION PACKAGES IN SIX SELECTED GEOGRAPHIC REGIONS AND SUB-POPULATIONS

CASE	PRE-PREGNANCY HEALTH	CARE DURING PREGNANCY/ DELIVERY	NEWBORN CARE	INFANT CARE	FETO-INFANT MORTALITY RATE
Case 1	2.1	0.9	0.8	1.2	5.0
Case 2	12.5	3.6	1.8	4.1	22.1
Case 3	1.9	9.2	8.2	3.4	22.7
Case 4	10.6	16.2	8.9	7.3	43.8
Case 5	2.5	12.6	9.5	0.8	55.4
Case 6	12.3	12.3	26.4	80.2	131.2

In order to present six cases for the exercise, data for the Care During Pregnancy package cells and data for the Care During Delivery package cells had to be combined. The denominator for these rates was cell 24 in Figure 2.29.

Compare Case 1 with Case 6. The FIMR in Case 1 is 5 per 1,000, and in Case 6, it is 131 per 1,000. Thus, the "Opportunity Gap" is 126 per 1,000 total births. The population in Case 1 has achieved a feto-infant mortality rate that is 26 times lower than that of Case 6. The largest gap occurs in the infant care package, interventions implemented in the postneonatal period after discharge from a skilled attendant. There are many cost effective interventions to reduce postneonatal mortality. Although the "Opportunity Gap" is large for all packages in Case 6, particular attention should first be given to the Infant Care Intervention Package. The situation is so bad that regardless of what the manager chooses to do, any relevant intervention done well will have an impact.

Compare Case 2 with Case 3 using Case 1 as the standard population: Both cases have the same feto-infant mortality rate. But individual comparison of the different gaps for each of the cell groupings reveals very different conclusions as to what should be done in each case. Case 2 has its largest difference in the Pre-Pregnancy Health, an "Opportunity Gap" is equal to 10.4 (12.5-2.1). A similar comparison for Case 3 reveals a difference of 0.2 in favor of Case 3. However, the largest gap for Case 3 is 8.3 (9.2-0 .9) in Care During Pregnancy. In Case 2, the impact indicators associated with Pre-Pregnancy Health need to be reviewed and the appropriate Intervention Package components need to be emphasized. In Case 3, those interventions associated with the Care During Pregnancy and Delivery need to be reviewed and the appropriate one emphasized.

Compare Case 3 with Case 5 using Case 1 as the standard population: For the last exercise, compare the Care During Pregnancy/Delivery gap in Case 3 (8.3) with the Care During Pregnancy/Delivery gap in Case 5 (11.7) - both are roughly the same magnitude. Yet, further investigation of each case reveals that the rate for C-sections (a major impact intervention in the Care During Pregnancy/Delivery) in Case 3 is 15 percent and in Case 5 it is 0.3 percent. The reason for this difference is identified through the subsequent review of the indicators associated with the Five A's. (Is the intervention available, acceptable, accessible, affordable, and appropriate?) The Five As will be discussed in more detail later in this section. In case 3, C-section were performed inappropriately resulting in excessive mortality. In case 5, although C-section were available, accessible, and affordable, the hospital where they were to be performed was unacceptable to the population.

BABIES ACTION 5. Analyze the Opportunity Gap by Time, Place and Person

During the previous actions the "Opportunity Gap" was defined in terms of the specific cell (i.e., cell 10) or in terms of the intervention package (pre-pregnancy health, care during pregnancy, care during delivery, pre-discharge care, or post-discharge care). The next step is to define the cell or gap in simple epidemiological terms (time, place, and person). The main purpose for describing the "Opportunity Gap" in these terms is to generate hypotheses as to why the gap exists.

Time analysis: Monitoring the trend of the BABIES matrix over time provides the degree of success of the interventions over time. Using the Opportunity Gap provides the necessary means to determine whether targeted populations are being adequately served to meet their needs.

Place analysis: Differences in the BABIES matrix according to place, even within districts, are key to determining the success of the intervention strategy, and identifying areas in need of service. Whether it is the village, district region, or country, it is important to determine whether differences in geography represent distinctive features of the political, economic, social, or health service environment.

Person analysis: Personal characteristics are fundamental to describing the health of a population. Characteristics such as age, education, race, marital status, socioeconomic level, risk behaviors, environmental exposures, and medical conditions help define subpopulations. These characteristics can be grouped together in a single variable with multiple categories. A commonly used sociodemographic grouping is age, race, and education and this has been previously described in Part Two, Section II. Medical profiles of subpopulations provide a means to target a subpopulation for specific medical care interventions.

Cause of death: Cause-specific mortality analysis has been a cornerstone for public health because of the ease with which it is related to intervention. This relationship, however, is not straightforward with maternal and perinatal outcomes. For many reasons, cause-specific mortality is not easily determined in most developing settings. In addition, interventions for the same cause of death are not necessarily the same. For example, asphyxia is a common cause of perinatal death. But the interventions related to asphyxia in a neonate weighing less than 1,500 grams are different from those most likely needed for a death in a neonate weighing greater than or equal to 2,500 grams.

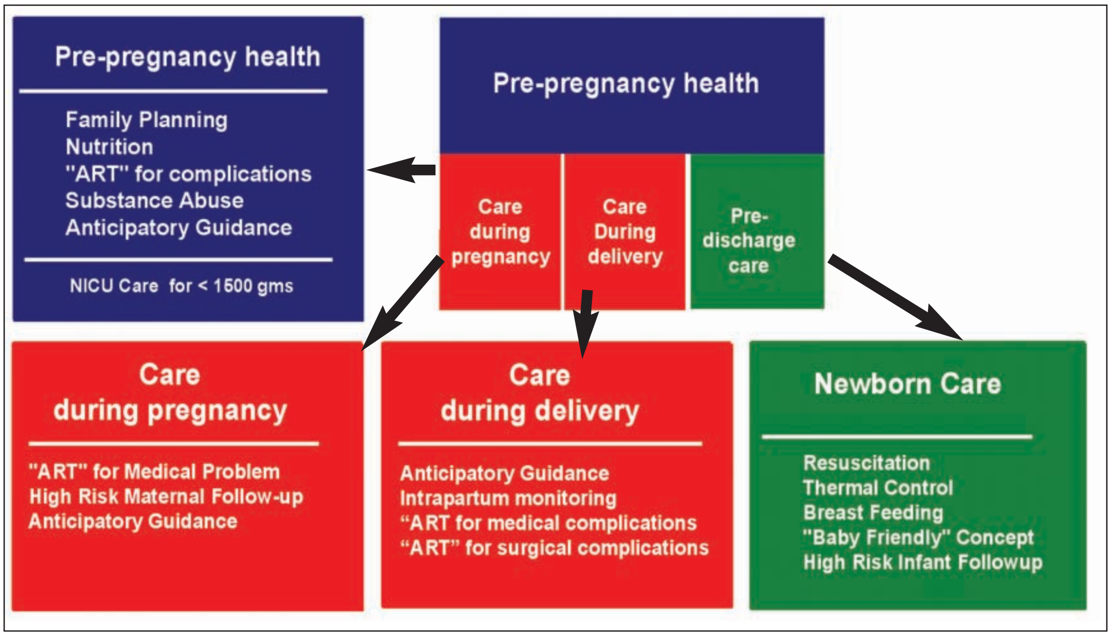
- **Unknown or unreliable cause of death:** In situations where the cause of death is unknown or unreliable, what can be done? Based on the pattern of data in terms of the intersection of birth weight and time of death, an inference can be made about causes of death. If the observed rate of the cell exceeds the expected, then the interventions meant to prevent those deaths are either not being carried out or they are being implemented incorrectly for some reason.

- **Reliable cause specific mortality:** In situations in which cause-specific mortality is reliable, one can be much more direct with the chosen intervention. The first step is to compare the cause-specific mortality rates for infants weighing greater tha or equal to 2,500 grams for defined geographical or institutional settings in the cells with optimal values. The "Opportunity Gap" can be identified again by comparison with a standard, such as the accepted mortality rate for deaths from neonatal asphyxia in a given birth-weight group. Problems can be identified by deviations from the chosen standard.

BABIES ACTION 6. Choose the Cell or Group of Cells Upon Which to Focus

The category with the largest "Opportunity Gap" may provide the program manager with an opportunity to reduce the greatest portion of the gap. However, some interventions may be more feasible and still address a significant portion of mortality. For example, neonatal tetanus may be easier to address than asphyxia among preterm babies. The manager needs to review underlying causes, such as poor quality obstetric care or delays in access to care, and make a decision about which the package is most feasible for the situation. Section V provides management tools to do this.

FIGURE 2.30
USING BABIES TO IDENTIFY PRIORITY INTERVENTION PACKAGES



BABIES ACTION 7. Assess Performance with Regard to the Chosen Focus Cell

Review the data about interventions relevant to that cell. One aid is the Five A's. Is the intervention available (capacity, knowledge, skills, and materials)? Is the intervention accessible (physically)? Is the intervention acceptable (culture, gender)? Is the intervention affordable (transportation, costs)? Is the intervention appropriate (according to standards/protocols)? Much more detail on possible interventions for each of these time periods will be described in the packages section in Part Four and the performance assessment section in Part Three. The program manager must develop a system of outcome and process indicators to monitor and evaluate the program.

BABIES ACTION 8. **Select Outcome and Process Indicators for Your Program and Develop the Local HMIS**

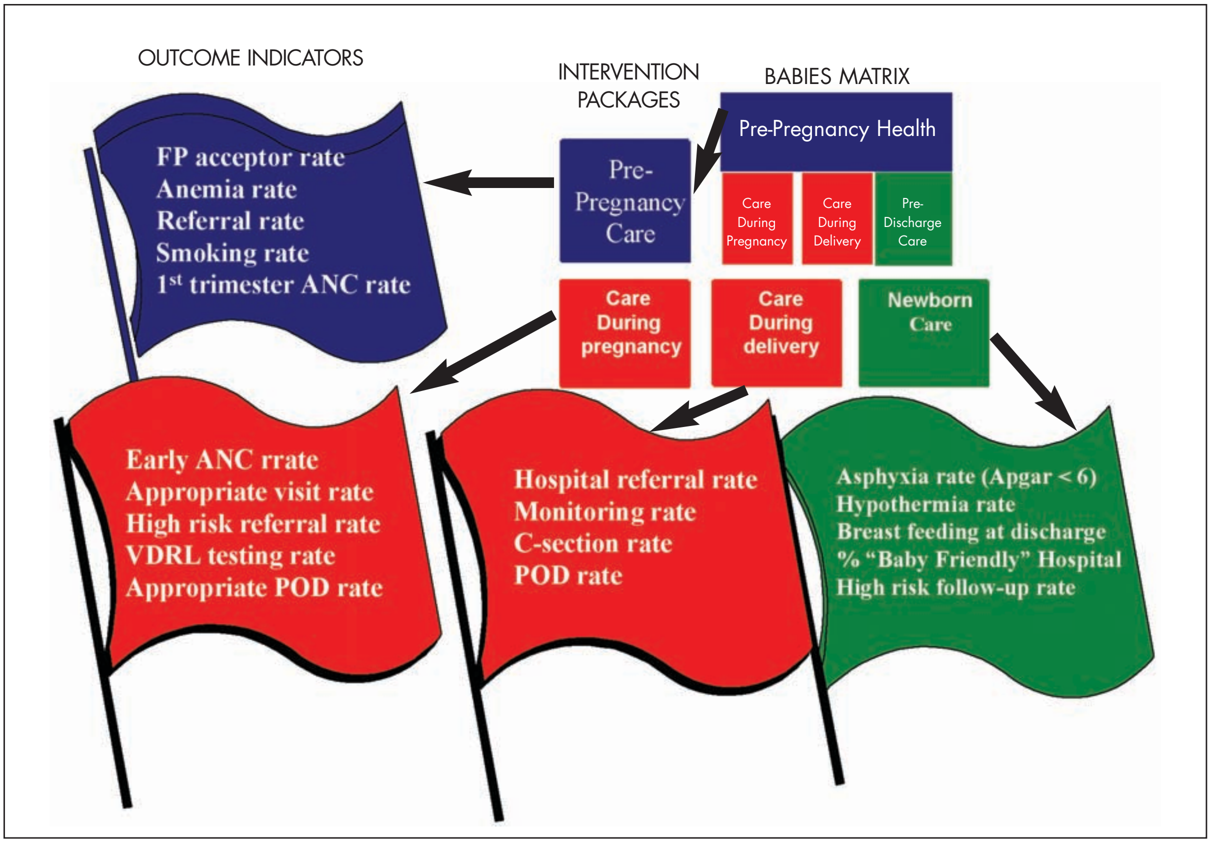
Resources, available technology, local concerns, existing services, current coverage of the population, and the ability to coordinate activities among the various partners are all elements in developing a strategy. The BABIES matrix links the “Opportunity Gap” with the Intervention Packages (Figure 2.30). These interventions have an associated impact indicator (Figures 2.29) that provides the program manager with a systematic way to set goals and objectives for the program. The program manager can avoids outcome displacement by using BABIES as the starting point for choosing of Intervention Packages.

BABIES ACTION 9. **Repeat the Above Steps in a Continuous Cycle of Improvement**

Outcome and process indicators for the intervention packages are chosen by the process previously described. Section V includes quality management tools that help determine which indicators meet the need of a given situation. It is important to identify the response to each of the indicators, so that what is supposed to happen when the indicator flag is raised is clearly understood.

BABIES ACTION 10. **Select the Intervention Strategy and Establish Goals and Objectives**

FIGURE 2.31
USING BABIES TO IDENTIFY INDICATORS ASSOCIATED WITH INTERVENTION PACKAGES



PANEL 2.3
LESSON LEARNED

THE COMMUNITY REVISES ITS MONITORING BOARD

In Kimba District, Tanzania, each pregnant woman in the village is represented by a pin. The pin is placed in the upper left-hand corner of the CMB. Upon completing the pregnancy, a separate pin for each mother and newborn is placed in the appropriate cell. Their objective is that all pins will be placed in the middle green column at birth and that all the mothers and babies make it to the green column at the far right. Since this is a real –time board only 60 percent of the population of mothers and infants have been followed to 9 months of age. It is not difficult to draw the conclusion that deaths during delivery are a major problem. Upon review, transportation during labor was identified as the key issue and the villages developed interventions plans to solve that problem.

Every pregnancy counts, so account for every pregnancy CARE

Pregnant women	Abortions	Fetal death		Alive at birth	Kifo baada ya kujifungua						Survivors @ year
		Antepartun fetal death	Intrapartum fetal death		< 24 hours	Day 1-<7	Days 7-28	Days 29-42	Months 2-6	Months 7-12	
			3	633	2						631
		5	7	516	2	4	4	2	2	1	501
		4	3	62	2	4	1	0	1	0	54
	0	7	4	20	6	5	1	0	0	0	8
Total	0	16	14	598	10	13	6	2	3	1	563

BABIES SUMMARY

BABIES (Birth weight and Age-at-death Boxes for an Intervention and Evaluation System) is an adaptable assessment tool that allows the program manager to collect, organize, analyze, and translate data into information for newborn health intervention. It combines two pieces of data:

- Age at the time of death of the fetus/newborn; and
- birth weight group.

BABIES is a simple system to define the newborn health problem, assess the performance of the HCDS, select effective interventions, and perform monitoring and evaluation.

BABIES brings together five concepts to assist the program manager to make decisions:

Concept 1	Time: age at death of fetus/neonate.
Concept 2	Birth-weight group or birth size of fetus/neonate.
Concept 3	Think in two dimensions – the birth weight and time at death matrix.
Concept 4	Interpreting the cells in BABIES and grouping into intervention packages.
Concept 5	The "Opportunity Gap."

There are ten action steps for implementing the BABIES matrix:

Action 1	Review data and adapt the matrix to program setting.
Action 2	Plot the data into the matrix.
Action 3	Convert raw data into rates.
Action 4	Calculate the "Opportunity Gap."
Action 5	Analyze the "Opportunity Gap" by time, person, place.
Action 6	Choose the cell or group of cells upon which to focus.
Action 7	Assess performance with regard to the chosen focus cell.
Action 8	Choose the intervention strategy and establish goals and objectives.
Action 9	Select outcome and process indicators for your program and develop HMIS.
Action 10	Repeat the cycle to achieve continuous improvement.

Indicators derived from BABIES serve as the outcome indicators for defining the "Opportunity Gap". In turn, these indicators are linked to impact indicators derived from the Intervention Packages for reducing the gap. In the next section, BABIES is linked to the quality management process. And in Part Three, monitoring and evaluation components of the step-by-step approach are outlined.

V. QUALITY MANAGEMENT IN NEWBORN HEALTH PROGRAMMING

A. The Principles of Quality Management

What is quality?
Many definitions of quality have been proposed. Quality of care must be defined in the light of technical standards and clients' expectations. While there is no single definition of health service quality applies in all situations, the definitions presented below may be helpful guides.

> *Quality is…"proper performance (according to standards) of interventions that are known to be safe, that are affordable to the society in question, and that have the ability to produce an impact on mortality, morbidity, disability, and malnutrition."*
>
> - M.I. Roemer and C. Montoya Aguilar, WHO, 1988
>
> *"Doing the right thing right, right away."*
>
> - Advocates of total quality management
>
> *"Quality is meeting the patient needs and reasonable expectations."*
>
> - Louis Smith, CDC.

Quality can be assessed only if there are standards with which to compare current practices. Standards/guidelines outline specific actions in a given clinical situation (i.e., WHO guidelines for care in pregnancy and childbirth), or they can describe appropriate ways to serve clients (i.e., showing respect). Although high quality may have a cost, the lack of quality also has a substantial cost. Unfortunately, the lack of quality is often paid through the loss of human life, resulting in the high maternal and fetal-neonatal mortality rates that exist today.

Quality and the program manager

Successful program managers need to be able to:

- manage human resources to increase productivity and quality of services through development of teams;
- obtain, allocate, and manage material resources;
- determine and justify priorities for interventions and allocations;
- monitor the effectiveness and efficiency of the program; and
- allocate and maximize their time and skills.

The aim of good management is to improve quality, not simply to "deliver the goods". Improvement involves building the capacity of the system and promoting sustainability.

The quality management process provides a mechanism for continuous on-the-spot improvement. Quality planning takes place by integrating one comprehensive planning system, communicating well up and down the organization, coordinating vertically and horizontally, and involving all participants in broadly defining the mission, vision, and detailed objectives of the program.

Quality management provides a framework for ensuring continuous improvement and a common language for talking about quality. Management information systems and computer applications provide information for intervention. Resource allocation and logistics management depends on factual information about needs, supply consistency, costs, and contingencies. Program managers must know how to produce documents for supply management and how to evaluate a supply system. From these agendas, program managers can develop health policies based on established priority needs and a cost-benefit analysis. Evaluation will be based both on outcome and on process.

Many publications promote the quality concepts and process. Whether this process is called Total Quality Management (TQM), Quality Assurance (QA), Continuous Quality Improvement Program, or the Quality Improvement Story is unimportant. All of the programs have similar components and basic steps that have the same goal - to improve quality. This section presents only the basic concepts, but more information on this topic is provided on the CD-ROM including the CDC's TQM Workbook, USAID's Quality Assurance Project materials, and CDC's Program Management: A Guide for Improving Program Decisions. Much of this section is adapted from these materials.

TOTAL: The loyalty and intelligence of every employee must be fully developed and used. Quality is everyone's responsibility. Quality can and must be supported at the upper levels of management, but the actual achievement of quality takes place at the interface between the patient and the service provider in the home or health care institution.

QUALITY: Quality management is a process to ensure patient or client satisfaction through involvement of all employees in reliably producing and delivering quality products or services. A process is a repetitive and systematic series of actions or operations in which resources are used to develop or deliver products or services. Processes involve people, activities, and methods.

MANAGEMENT: Management is a process by which one plans, implements, and evaluates an organized response to a health problem[12]. The health programming model consists of all the people and actions whose primary purpose is to improve health. In this model, people, technology, and resources are organized and directed toward the solution of a problem through management. The program manager's skills are crucial to success.

B. The Quality Triangle

The key building blocks for quality are policy management, the team, and daily attention to quality work.

- **Policy Management:** Quality improvement needs to be supported by enabling policies, which creates an enabling institutional environment to support the quality improvement practices. The quality management process replaces many old management tenets with more modern ones. For example, the function of a supervisor changes from that of an inspector general to that of a facilitator. Supervisors work for employees as much as employees work for supervisors. Another paradigm shift in management involves who defines quality in terms of service. In the old environment, managers say they know what the customer wants and what quality is. In the quality management environment, the patients participate directly in the definition of quality.

Since the people who are doing the job are the experts, they will often have the best solutions to the problem. By using quality management techniques, the team can identify mistakes and deficiencies, learn from them, correct them, and continue to improve the program.

▲ **Teams:** A team is a high-performance task group whose members are interdependent and share common performance objectives. A team's purpose is to improve the quality of products and services, develop the skills and abilities of the team members, promote communication and working together, and enhance the quality of work life. Teams have structure, focus, and procedures that are important to them and, more importantly, to their patients. Basic types of teams include task, functional, cross-functional, and lead teams.

Teamwork is an essential element of quality management, requiring planning and clear communication. In providing a structured environment for employees to work together, quality teams identify a problem area and reasons for solving the problem, select a workable problem and set targets, analyze the problem's causes, plan and implement countermeasures to correct those causes, confirm that the problem has been improved and the targets met, prevent future occurrence of the problem, and plan for solving other problems.

Consensus, which implies voluntary consent, is the primary method of team decision-making. Although everyone might not share the same degree of enthusiasm for the solution, they must agree to support it. Consensus promotes a win-win situation and provides some level of ownership for the decision or solution. The consensus process can be a good team-building tool. Everyone involved in the discussion explores alternatives, encourages differences to clarify issues, and is cautious of quick solutions. The team uses data to make consensus easier, thus abiding by one of the fundamental principle, management by fact.

A more complete description of teams is found on the CD-ROM.

▲ **Quality in daily work:** Quality is a broad concept. Experts describe several distinct quality dimensions that vary in importance depending on the context in which the team operates (Table 2.16). Not all eight dimensions deserve equal weight in every program. Activities may address one or more dimensions. The dimensions of quality are a useful framework that helps health teams define and analyze their problems and to measure the their results compared to program standards. The eight dimensions are briefly discussed in Table 2.16. More details are available on the CD-ROM.

TABLE 2.17
DIMENSIONS OF QUALITY

DIMENSION	DEFINITION
Access to services	Access means that health care services are unrestricted by geographic, economic, social, cultural, organizational, or linguistic barriers.
Amenities	Amenities refer to the features of health services that do not directly relate to clinical effectiveness but may enhance the client's satisfaction and willingness to return to the facility for subsequent health care needs.
Effectiveness	The quality of health services depends on the effectiveness of service delivery norms and clinical guidelines. Assessing the dimension of effectiveness answers the question. Does the procedure or treatment, when correctly applied, lead to the desired results?
Efficiency	The efficiency of health services is an important dimension of quality because it affects product and service affordability and because health care resources are usually limited.
Continuity	Continuity means that the client receives the complete range of health services that he or she needs, without interruption, cessation, or unnecessary repetition of diagnosis or treatment.
Safety	Safety means minimizing the risks of injury, infection, harmful side effects, or other dangers related to service delivery. Safety involves the provider as well as the patient.
Technical competence	Technical competence refers to the skills, capability, and actual performance of health providers, managers, and support staff.
Interpersonal relations	The dimension of interpersonal relations refers to the interaction between providers and clients, managers and health care providers, and the health team and the community.

Source: Quality Assurance of Health Care in Developing Countries, USAID QAP/CORE/CSTS, June 1999.

C. Foundational Principles for Total Quality Management

There are four foundational principles that apply to total quality management: client satisfaction, management by fact, the plan-do-check-act cycle, and respect for people.

TQM PRINCIPLE 1: Client Satisfaction

Quality management promotes a client-centered orientation within organizations. Everyone in a quality organization is part of a client-provider chain. The program manager must first align patient needs and provider capabilities and then must meet reasonable, agreed-upon requirements.

TQM PRINCIPLE 2: **Management by Fact**

At the root of quality management is management by fact. Decisions are made and actions carried out by translating data into information rather than trusting instinct, perceptions, or individual prejudices. In the management by fact environment, everyone has a common framework for understanding what needs to be done and what is being done. Communication is more direct, execution more predictable, and evaluation more reliable. Data are more likely to be correct and serve as a common understanding. This is emphasized and applied throughout Part Three.

Management by fact includes three processes:

- collect objective data to validate the information;
- analyze the data; and
- respond by using facts as the basis for action and make decisions based on these data rather than on instinct, preconceptions, or prejudices.

Quality  **Root**

Without data,
you are just another
person with an opinion

In many situations, teams are data-rich but information-poor. In Section II, information was defined as a difference that makes a difference. More thought needs to go into the analytical step by which data are transformed into indicators. The degree and/or frequency of conformance of the quality indicators help the program manager measure the gap between what is and what should be. Such measurement compares the program's present performance versus the client's requirements, and leads to the understanding that…

…If you can't measure it, you can't manage it.

As previously discussed, the "Opportunity Gap" is the disparity between what is observed and what is expected. It helps to answer the question, *Have we chosen the right things to do?* When the "Opportunity Gap" is defined in terms of total quality management, the main questions are:

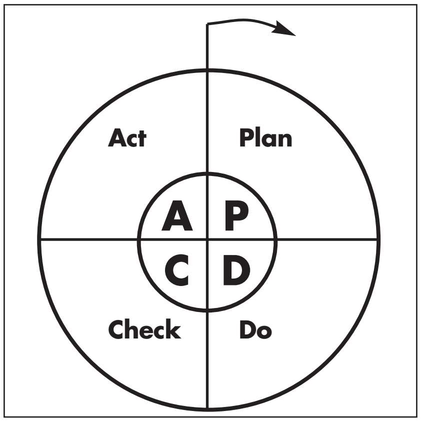
What is *currently happening* with the
process/product/service that is the target for improvement?
What *should be happening* with the
process/product/service that is the target for improvement?

This distinction helps us answer the question, *Are the interventions being done in the right way?*

TQM PRINCIPLE 3:	The Plan-Do-Check-Act Cycle

The plan-do-check-act (PDCA) cycle (Figure 2.30) provides a simple model that corresponds to the way human beings operate. It begins by setting goals based on client needs and planning how to achieve them (Plan). It continues by implementing or trying out what is planned to see how it works (Do). It performs checks during and after the service, gathers and analyzes data to find out what happened, what worked, and what did not (Check). Then, on the basis of the analysis, it acts to improve the service (Act).

FIGURE 2.32
PLAN-DO-CHECK-ACT CYCLE



TQM PRINCIPLE 4	Respect for People

High quality is attained only through full employee commitment and participation. People have needs just as the organization does. Program managers and supervisors should treat their team members as they want their clients to be treated. The quality management model creates a sense of purpose in the workplace and keeps employees informed and involved. Most important, it trains employees so they are the best they can be for clients and for themselves. Every team will have financial constraints, but the quality management process helps use the resources in the most effective and efficient manner. It helps employees communicate better, and authority and responsibility are delegated whenever practical.

D. Quality Improvement Story

The quality improvement (QI) story is a seven-step problem-solving process. It is a systematic, data-based approach to problem-solving. The QI story helps a team to organize, collect and analyze data, and to determine how well they are doing. It is a guide to the problem-solving process, and it helps the team use the Plan-Do-Check-Act cycle in the problem-solving process. Figure 2.33 is a pictorial representation of the QI Story and some of the tools used in the process. Throughout the description of the QI story, quality tools will be mentioned without defining them, but they will be defined later.

FIGURE 2.33
QUALITY IMPROVEMENT STORY

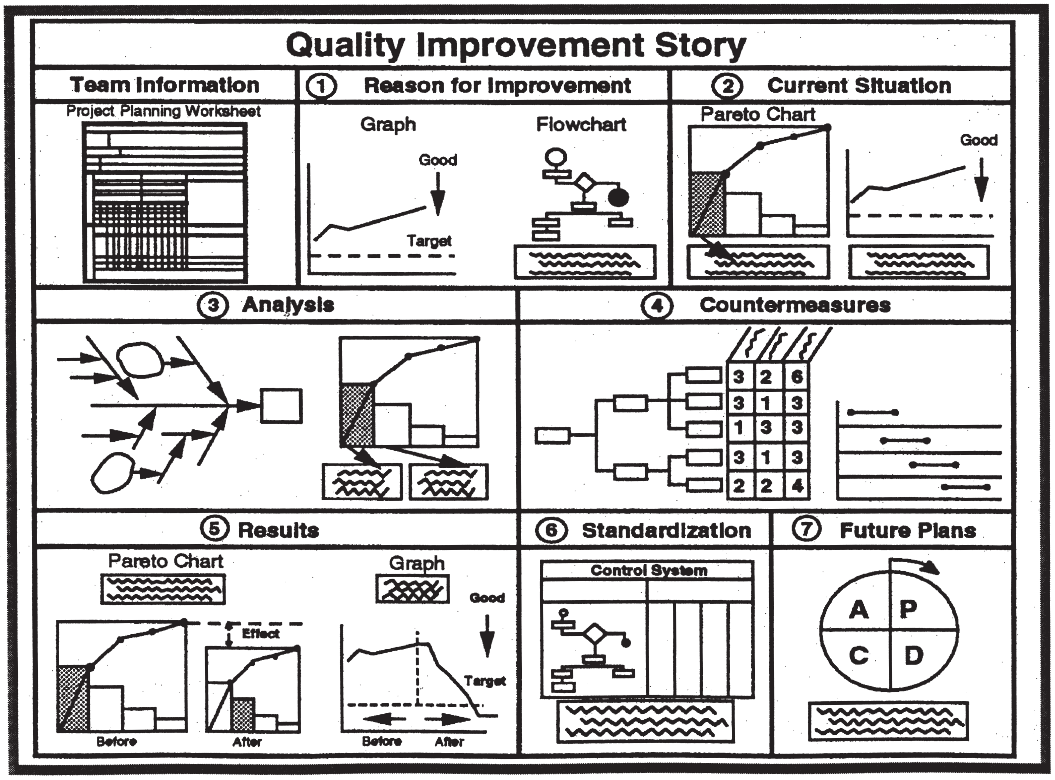


TABLE 2.18
STEPS IN THE QUALITY IMPROVEMENT STORY

QI step 1.	The reason for improvement.
QI step 2.	Current situation: what exactly is the problem?
QI step 3.	Analysis: what is causing the problem?
QI step 4.	Countermeasures: what are we going to do about what is causing the problem?
QI step 5.	Results: how well did we do in eliminating the problem?
QI step 6.	Standardization: how do we maintain the goal?
QI step 7.	Future plans: what is next?

QI. Step 1. The reason for improvement: This step is in Plan part of the plan-do-check-act cycle. A problem exists! The objective of the step is to identify a **theme** (problem) and the reason for working on it. Using the **theme selection matrix** and other tools, a problem is selected. The selection should be based on collected data (facts) and should be patient-oriented. There should be a graph or chart showing the quality indicator that will be used to track progress in reducing or eliminating the problem. The same type of graph will be used later in Step 5 for comparison. A **flowchart** may or may not be necessary, but one should generally be developed for short-cycle time processes.

At the completion of Step 1, the team has written a **theme statement** and identified an indicator that accurately represents its variation. The gap between what is and what should be (a numerical indication of our problem) will be the reason for improvement. A plan or schedule for completing the QI story steps may be completed.

QI. Step 2. Current situation: What exactly is the problem?: This step is in the Plan part of the plan-do-check-act cycle. After selecting a problem, the team sets a target for improvement based on the gap between what is and what should be. Different products are produced in this step. Data will be collected (if they do not already exist) on all aspects of the theme by means of **checksheets,** and they may be displayed several different ways. The **Pareto** chart shows relative significance and is most often used to stratify the theme into manageable chunks. It also shows us which aspect of the theme is most important and most urgent to address. **Stratification** must continue until the problem is specific enough to analyze. The graph selected to track the problem will also be used to compare progress on resolving the problem in Step 5, and it may be different from that used in Step 1. (Step 1 generally uses a line graph, Step 2 generally a Pareto chart.) Table 2.19 contains the characteristics of a good problem statement and gives an example.

At the completion of QI Step 2, the team should have a reasonable, written theme (problem) statement addressing the gap, a numerical objective for the team to use as an improvement goal, and valid customer requirements. A management presentation is now given to get management's approval to work on the problem and use resources.

Example: Writing a problem statement and setting a an objective for improvement (What is our problem, exactly? How much can we improve right now?) (Table 2.19.)

TABLE 2.19
PROBLEM STATEMENT EXAMPLE

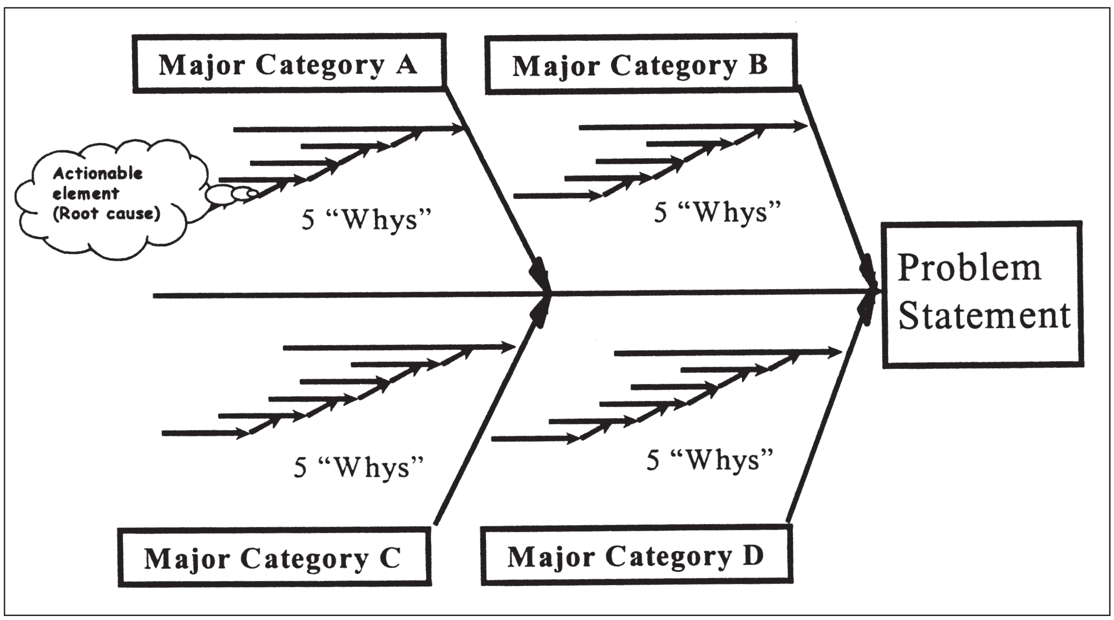
Criteria	(A)	(B)	(C)	(D)	(E)	(F)
Problem Statement (Who, what, when, where, how, how many.)	**States What is wrong?" – the effect**	**It is measurable**	**It is specific. Avoids broad categories.**	**Focuses on the gap between what is and what should be.**	**Stated objectively? Avoids questions?**	**Focuses on the "pain" how customers are affected.**
In 1998, the NMR was 10% higher than the objective, increasing our regional mortality and jeopardizing donor funding for prevention strategies.	Yes	Yes	Yes	Gap is clear. 10% too high.	Yes	Yes, explicit.

Objectives are steps to meeting a goal. The goal in this example could be to meet the NMR goal in the year 2002. Objectives should be challenging but achievable in a reasonable time, typically in a year or preferably less. Remember, the team is trying to lessen the effect of the problem area or theme by reducing a specific problem that is a major contributor. The problem area or theme from which this problem statement might have been stratified could be, "To lower our country's maternal and infant mortality rates to 15/1000, the lowest in the region or lower." Example objectives:

1. Reduce the neonatal mortality rate by 5 percent in 2 years.
2. Reduce the neonatal mortality rate by 2 percent per year.

QI. Step 3. Analysis: What is causing the problem?: This step is in the Plan part of the plan-do-check-act cycle. Its objective is to identify and verify the root cause(s) of the problem. The team completes a cause and effect analysis using the cause and effect or fishbone diagram (Figure 2.34). The team verifies the root causes with data to support their conclusions. They may need to run some experiments or collect data over time. The root causes must be based in fact and taken down to a cause on which the team can take action.

FIGURE 2.34
THE FISHBONE DIAGRAM

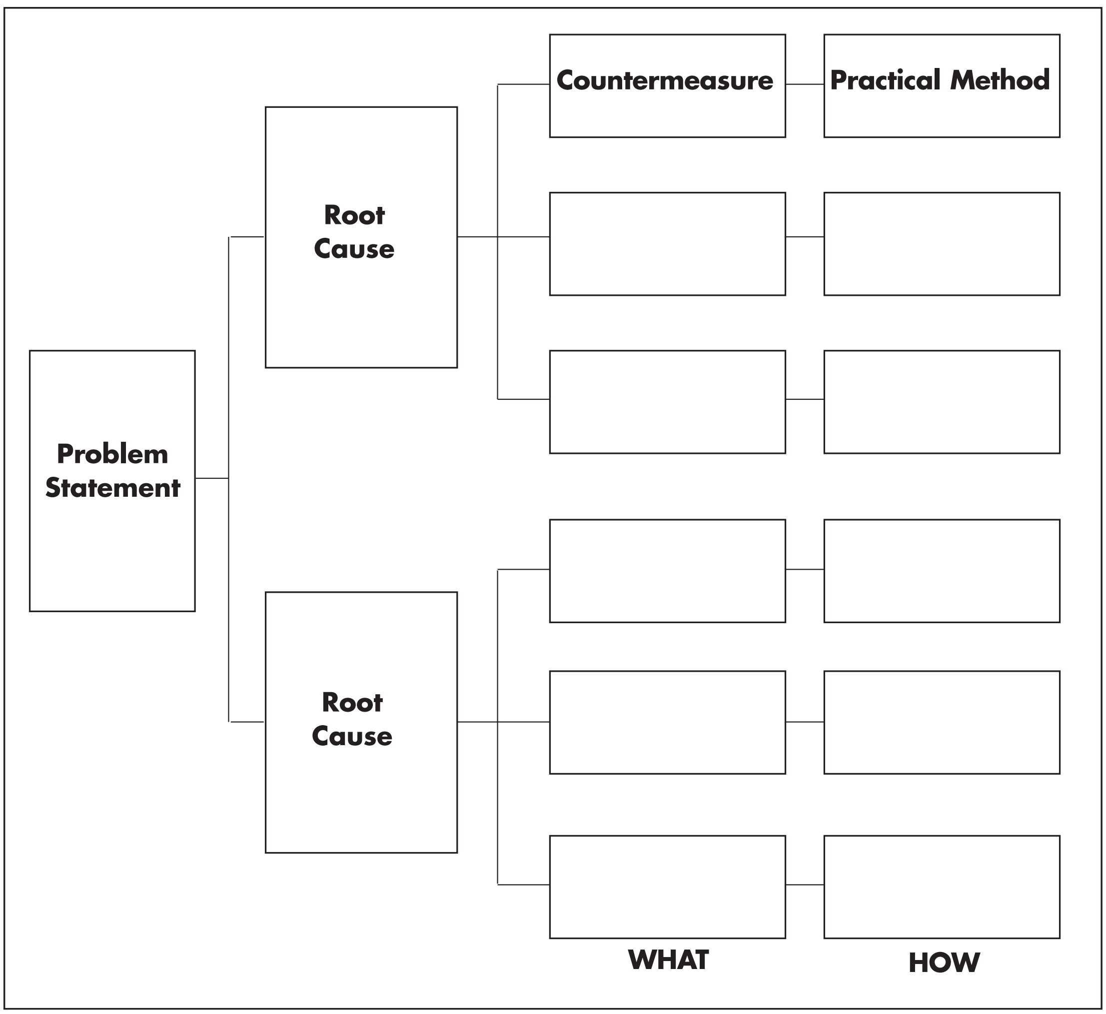


Since the fishbone diagram is so important to the quality management process, its construction is reviewed here. The fishbone diagram construction starts with the problem statement the team developed in the previous steps (placed in the head of the fish). The team decides on the major categories under which a root cause might fall (the major boxes in Figure 2.33). The five generic categories are people, methods, machine, material, and environment or others the team feels are appropriate. These major categories can be obtained from brainstorming and looking at the process flowchart if available, major process activities, significant geographic areas, or other analysis on the problem statement. For each of the major categories the team will ask a series of logical questions along the skeleton (bones) of the major categories. The team asks "why" five times for each bone, or until the team reaches an actionable level. The team uses the process just described to arrive at two or three actionable items. After completing several logic chains, the team circles the most likely root causes for further verification by data. Another applied example is given in Part Three (Figure 3.2).

At the completion of QI Step 3, the team should have identified the actionable root cause with the greatest probable impact and verified it as a root cause with data. This can be done through the use of scatter diagrams, interviews, surveys, etc.

QI. Step 4. Countermeasures: What are we going to do about what's causing the problem?: This step is in the Do part of the plan-do-check-act cycle. The objective of this step is to identify, plan and implement countermeasures (proposed solutions) that will correct the identified root cause(s) of the problem. The team uses a countermeasure matrix (Figure 2.35) to select the most effective and feasible countermeasure(s), consistent with the patient's valid requirements, which should reduce or eliminate the problem (or parts of it). An action plan for implementation of the countermeasure(s) shows who takes what actions, when they take them, where they take them, and how they are taken.

FIGURE 2.35
THE COUNTERMEASURE MATRIX



Since the countermeasure matrix is so important to the quality management process, its construction is reviewed here. After verifying the significant root causes, the team fills in what it can of the first two columns in Figure 2.35, the problem statement and root causes. Next, the team identifies countermeasures that address each root cause. A countermeasure is ***what*** the team proposes to do to reduce or eliminate the corresponding root cause. For each countermeasure, one or more practical methods, or specific tasks, that will enable the implementation of the countermeasures are discussed. A practical method answers ***how*** the countermeasures will be accomplished. The team now estimates the effectiveness of the countermeasures at reducing or eliminating the root cause. Higher ratings go to those estimated to be more effective. The team next estimates the feasibility of the practical methods. This estimate usually includes consideration of cost, time, personnel, and other factors relevant to the situation. The team decides whether to implement countermeasures, and how many on the basis of the available resources and the urgency of the need to meet the improvement target. In this action the team is evaluating the effectiveness of the countermeasure and the feasibility of the practical method.

Consensus in decision-making is needed during the use of the countermeasure matrix. As a last resort, numerical ratings may be averaged to arrive at an overall rating for a given countermeasure or practical method.

At the completion of QI Step 4, the team has definite plans for implementing a countermeasure and for monitoring its effectiveness in reaching their target. Before implementation, a management presentation is given to get management's approval to actually change the way some persons do their business. Management will also provide assistance in getting the needed support from other parts of the organization.

QI. Step 5. Results: How well did we do in eliminating the problem?: This step is in the Check part of the plan-do-check-act cycle. The objective is to determine whether the problem and its root causes have been decreased and the target for improvement has been met. The team compares the data collected (monitoring the effect of the countermeasure) with the data collected and plotted in Step 2. The same graph and indicator must be used to make a comparison valid and easy to understand. Each previous step had considerable activity, but QI Step 5 has much less because it is simply a comparison of two sets of data.

At the completion of QI Step 5, the team has measured how close they came to meeting their target for improvement. They leave QI Step 5 with another decision. Did they do well enough? If so, they can move to Step 6. If not, they may need to go back to Step 4 and implement another countermeasure, or go back to Step 3 and identify some additional root causes.

QI. Step 6. Standardization: How do we maintain the gains?: This step is in the Act part of the plan-do-check-act cycle. The objective is to prevent the problem and its root causes from recurring. The team must put in place the structures and systems to make the countermeasure part of daily work. Employees may need to be trained in the new procedures, and checks should be put in place to monitor their effectiveness. Specific areas are considered for replication of the new procedures. Any other parts of the organization that can benefit from the improvement are given the details of the countermeasure.

At the completion of QI Step 6, the team should have clearly met the target set in QI Step 2 or have come close enough to meet the patient's valid requirements. They should have taken the necessary actions to maintain the improvements achieved thus far.

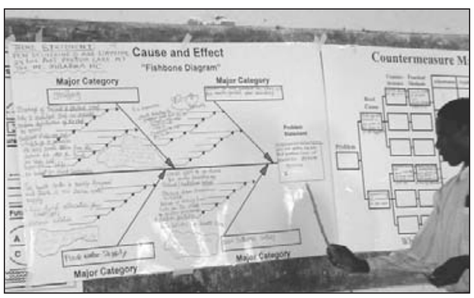
QI. Step 7. Future plans: What is next?: This step is in the Act part of the plan-do-check-act cycle. The objective is to evaluate the team's effectiveness and decide what is to be done with any remaining problems. The team considers any remaining problems from QI Step 2 as well as any remaining themes from the theme selection matrix in QI Step 1.

At the completion of QI Step 7, the team should have plans for further problem-solving actions or plans for maintaining their gains and looking for more improvement opportunities. In Table 2.18, the seven steps are listed, tools and techniques are identified, and objectives and checkpoints provided for each of the steps. Panel 2.4 gives a description of improving the quality of obstetric services in Guatemala as an example of how it is all brought togeher.

PANEL 2.4
LESSONS LEARNED
USING FISHBONE

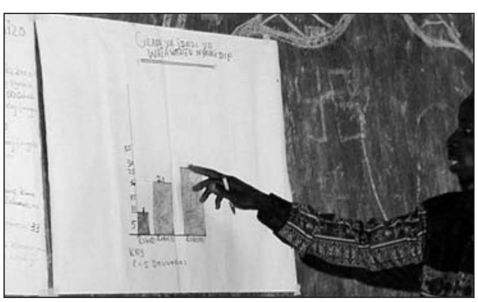
In Tanzania, health care workers wanted to assess why women would not deliver at the health center or remain in the center after birth for a 24-hour period.

The main categories of their fishbone were culture/taboos, space not sufficient, staff, and money. After asking the five why's for each of the categories, the team identified several actionable clouds. The root causes were the community's cultural concerns about a man being present at delivery, insufficient measures to ensure privacy during postpartum care, failure of a female-in-charge always to be present for deliveries, and the lack of community knowledge of the importance of delivering at the facility and remaining for at least 24 hours.



The main countermeasures were education and renovation of the facility

The goal for the dispensary was to go from zero to 25 percent of women delivering at the facility within 3 months and to have all the women stay at least 24 hours or more. Initially, the team focused on the women, staying 24 hours after delivery, but the problem was re-examined and the main focus shifted to increasing the number delivering at the facility. The main root cause for that problem was thought to be the lack of a female attendant.



They successfully requested district health management team to provide a midwife. At the same time, the village committee funded a curtain to partition the postpartum room to provide privacy. Deliveries rose from 9 to 21 to 33 (as seen in the histogram in the figure to the left) over the course of 3 months within the quarter. In the last month, 75 percent of the women stayed 24 hours or longer. The prolonged stay also provided an opportunity to develop a register book in which staff record the name, time arrived, time left, and vaccinations received, and they develop a plan for follow-up care if necessary.

Source: Unpublished report, CARE/CDC Health Initiative Project in Kwimba District, Tanzania, (2000).

E. Quality Tools

Many quality tools are at the disposal of the program manager. To the beginner, their number and complexity might seem overwhelming, and therefore discourage their use. It is important to remember that 80 percent of problems can be solved with three analytical tools, 95 percent can be solved with seven tools. Table 2.20 reviews the QI story and briefly introduces some of the tools.

Table 2.20 outlines which steps in the QI story the can best be utilized.

TABLE 2.20
THE QI STORY REVIEW

	QI STORY STEPS	TOOLS/TECHNIQUES	OBJECTIVE AND CHECKPOINTS
PLAN	① Reason for improvement (A problem exists)	Project planning sheet Graph Control Chart Process flowchart Other:	*To identify a theme (problem area) and the reason for working on it.* 1. The criteria for selection were customer-oriented. 2. The indicator correctly represented the theme. 3. The need for improvement was demonstrated with data. 4. A schedule for improvement was demonstrated with data.
	② Current situation	Control Chart Histogram Graph Pareto Chart Checksheet Other	*To select a problem and set a target for improvement.* 5. The situation was stratified to a component level specific enough to analyze. 6. Customers valid requirements were identified. 7. The problem statement addressed the gap between the current and targeted values. 8. The methodology used in establishing target/goal was identified.
	③ Analysis	Cause and effect Analysis Histogram Graph Pareto chart Scatter diagram Checksheet Other	*To identify and verify the root causes of the problem.* 9. Cause-and-effect analysis was performed on the problem. 10. Root causes were taken to an actionable level. 11. Root causes were taken to an actionable level. 12. Data were used to verify the root causes.
DO	④ Counter-measures	Cost estimation Countermeasures matrix Barriers and aids Action plan Other	*To plan and implement countermeasures that will correct the root causes of the problem.* 13. Selected countermeasures attacked the verified root causes. 14. Countermeasures were consistent with meeting customer valid requirements. 15. Countermeasures were cost-beneficial. 16. Action plan answered who, what, when, where, and how. 17. Action plans reflected the barriers and aids necessary for successful implementation.
CHECK	⑤ Results	Graph Control chart Pareto chart Histogram Other	*To confirm that the problem and its root causes have been decreased, and the target for improvement has been met.* 18. Root causes have been reduced. 19. Tracking (quality) indicator was the same one used in Step 1 – Reason for improvement. 20. Results met or exceeded target (if not, cause was addressed).
ACT	⑥ Standardization	Control chart Graph Control System Procedure/Std. Training Other	*To prevent the problem and its root causes from recurring.* 21. Method to assure that countermeasures become part of daily work was developed (include applicable training). 22. Periodic checks were put in place with assigned responsibilities to monitor the countermeasures. 23. Specific areas for replication were considered.
	⑦ Future plans	Action plan Other	*To plan what is to be done about any remaining problems and to evaluate the team's effectiveness.* 24. Any remaining components of the theme will be addressed. 25. Applied PDCA to lessons learned.

TABLE 2.21
SELECTED QUALITY MANAGEMENT TOOL DESCRIPTION

	WHAT IS IT?	WHY IS IT USEFUL?	WHEN IS IT USED?
Brainstorming	A way to use a group of people to quickly generate, clarify, and evaluate a long list of ideas.	Makes use of creative thinking and encourages participation.	Anytime data gathering is needed ...to collect problem areas, identify root causes, flowchart, identify countermeasures, etc.
Theme selection matrix.	A technique that helps the team quickly select a problem area.	Allows teams to rank the 3-5 problem areas by considering the impact on the customer and the need to improve.	When a team has identified more than one problem area to work on and it needs to reach consensus on which one is most urgent and important.
Problem statement	A way to summarize and express the findings (through Step 2) with clarity and objectivity. A good problem statement describes in specific, concrete terms what the data have shown. "This our problem."	To concisely communicate the issue at hand; for the team members, managers, supervisors, during presentations, etc.	A new problem statement is written for every problem-solving effort. As one bar in the Pareto Chart in Step 2 is reduced or eliminated, new statements are written to eliminate or reduce other bars.
Histogram	A visual representation of the spread or distribution of data. Data are represented by a series of bars with heights proportional to the frequency of occurrence.	Can give a good idea of how well our customers' specifications (valid requirements) are met. The information allows improved decision- making.	They can give us a good idea of how well we are meeting our customers' specifications (valid requirements). The information allows for improved decision making.
Cause and effect diagram (fishbone diagram)	A graphic composed of lines and words to represent a meaningful relationship between an effect and its causes.	The purpose is to identify suspected root causes of a problem.	It helps teams reach a common understanding of problems, exposes gaps in knowledge, directs teams towards actionable methods for reducing their problems, and is easy to use.
Action Plan	This plan catalogs all activities to be performed to ensure successful implementation of the countermeasures.	Plans include the practical methods to be used and any actions necessary to offset any remaining barriers.	In Step 4, as part of the countermeasure matrix.
Countermeasure matrix	A matrix of factors to help team members show the relationship among the problem statement, root causes and countermeasures.	Problem solving teams use it to ensure that countermeasures address the significant root causes of the problem.	Anytime a problem-solving team needs to identify countermeasures that will efficiently address the significant root causes of a problem.

More details are available on the CD-ROM.

The *Quality Toolbox* uses three questions to help program managers decide how to choose and apply tools at the appropriate times during the process of quality management[12,13].

1. **What does the team want to do with the tool?** Quality tools can be grouped according to what the team will do with them. Certain tools help a team come up with new ideas or organize many ideas. Others help in understanding a work process, discovering the cause of a problem, planning what to do, collecting and analyzing data, or evaluating how well you have done something. With time, the team will gain experience in cross-referencing the different ways to group the tools (since many have multiple uses) and will become quite proficient in their choice.

2. **At which step in the QI story is the team involved?** Table 2.22 presents a matrix that relates the use of the seven analytical tools to the QI story steps. Most are used in the first two steps, Reason for Improvement and Current Situation. Other process and planning tools facilitate the work of the team as they move through the seven steps. They are also described briefly in Table 2.21.

3. **Does the team need to expand or to focus its thinking?** The quality management process offers alternating exercises for expanding a team's thoughts on many different ideas or focusing its thoughts on specific ideas. In the expansion mode, the team generates new, creative, and innovative ideas. In the focus mode, the team narrows its thinking.

The process works like this. The team is confronted with many problems from which to choose i.e. indicators from graphs or checksheets. It uses focusing tools, such as the Pareto Chart, to decide which to choose. There are potentially many causes for the problem. It uses focusing tools, such as the fishbone diagram, to determine the root cause. The team proposes many solutions and then chooses which are most likely to work using the countermeasure matrix. The team uses the same indicators identified in QI Step 2 to evaluate whether the countermeasures were successful. With experience in using only a few tools, the team gains confidence in working together and is able to expand its own capabilities in the use of more tools.

TABLE 2.22
QUALITY TOOLS USED IN THE QI STEPS AND THEIR RELATIONSHIP TO THE PDCA CYCLE

	Most often used in which QI Step				
PCDA		**Plan**		**Do**	**Check and Act**
Tool	① **Reason for Improvement**	② **Current Situation**	③ **Analysis**	④ **Counter-measures**	⑤⑥⑦ **Results Standardization Future Plans**
Checksheet	X	X	X	X	X
Graph	X	X			X
Pareto chart	X	X			
Cause and effect diagram		X	X		X
Histogram	X		X		X
Scatter diagram	X	X			
Control chart					

PANEL 2.5
LESSON LEARNED

IMPROVING THE QUALITY OF OBSTETRIC SERVICES IN GUATEMALA

The Quality Assurance Project gives ten steps of quality design that have been developed to serve as guidelines for those involved in project design in developing countries at various health system levels, from community to national. They steps of quality design are:

1. Select the process to be designed;
2. Identify internal and external clients;
3. Identify and prioritize client needs and expectations;
4. Define the objective of the new design;
5. Create flowchart of main activities of process;
6. Link client needs with each activity on flowchart;
7. Identify key elements of new design that relate to priority client needs for each activity on the flowchart;
8. Describe the new process;
9. Error proof: test design for robustness and reliability; and
10. Plan, implement, and monitor new process.

These steps were applied in a project in rural Guatemala, where maternal mortality is estimated to be 190 per 100,000 births. Seven public hospitals set up quality assessment projects aiming to improve the quality of maternal care services, with the longer-term vision of reducing maternal mortality. Support was obtained from the hospital management, and a team was identified for each hospital. A 4-day training workshop for all team members gave an introduction to the quality-design steps and tools and allowed each team to select a process to be redesigned. Each of the hospitals identified a priority service to be improved such as triage of obstetric patients or obstetric surgery.

The teams met weekly for the next 5 months, working through the steps to redesign the chosen process. Client focus groups were part of the redesigning. Six of the seven teams completed their designs within nine months, resulting in improvements ranging from more privacy for women in labor, to a new theatre for obstetric emergencies. One team dropped out because of lack of support from hospital management.

The teams also identified several lessons learned that would improve the efficiency of other quality improvement process teams.

- Facilitators play a critical role in the design process and should be trained well in advance so that they know the methodology along with its weaknesses and limitations.
- Facilitators should clearly explain to team members what to expect (role within team, time commitment, budgetary limits, data monitoring)
- An achievable project should be selected first as an overlay ambitious selection of design can result in a long complex process that loses team momentum.
- Setting target dates for certain changes (benchmarking) reduces implementation time
- Possible hospital staff resistance should be anticipated and addressed in the change-management plan.
- Active support from hospital management should be encouraged by specifying what leadership can do and keeping leadership informed of progress.
- Training in the quality-design methodology should be reinforced when the teams reach steps 9 and 10 - error proofing and planning, implementing, and monitoring.

Source: USAID QAP/CORE/CSTS. Quality assurance of health care in developing countries. June 1999.

F. Capacity-building

Personnel are the chief resource in any program. The individuals who must make health care decisions and take appropriate action include pregnant women, their families, untrained community providers, trained birth attendants, nurses, nurse midwives, physicians, and program managers.

Each level of care requires a certain level of ability, generally achieved through training. In some cases, the training contains only information or promotion; in others, it contains full curricula and practice. For effective training to take place, special plans need to be made for each of the five components of training in Table 2.23.

TABLE 2.23
REQUIREMENTS OF EFFECTIVE TRAINING

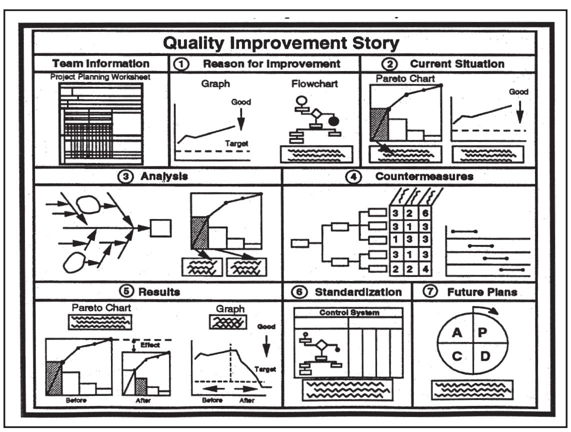
TRAINING COMPONENT	TASK
Needs assessment	Determine the categories and number of health personnel that exist. Conduct a performance assessment as described in Part two, Problem definition section.
Task analysis	What are the skills required to undertake a new technology or action? What specific knowledge and action sequences are needed to adequately perform a function. These needs form the content for training.
Design	Determine what task is to be performed by whom. Set the educational objectives, select the appropriate training methods, and determine how to evaluate training adequacy.
Development	Materials and training sessions must be at an appropriate level for the health care provider receiving training. Train-the-trainer materials may be necessary to support the training sessions. Development includes field testing.
Delivery	Locate facilities, supplies, and equipment as needed. Promote the availability of training or recruit trainees. In many cases, an infrastructure may need to be built at the district level to support the training.

SUMMARY OF QUALITY MANAGEMENT

Quality management is a process to ensure customer satisfaction through involvement of all employees in reliably producing and delivering quality products or services.

Quality management has three major components. The policy management component promotes a paradigm shift to modern tenets of management. Supervisors go from being inspector general to facilitator. Supervisors work for employees as much as employees work for supervisors. Teams improve the quality of products and services, develop skills and abilities of team members, promote communication and working together, and enhance quality of work life. Team development is an essential core of quality management. Quality in daily work is the primary job of quality teams, and it is everyone's responsibility.

Quality management has four fundamental principles. Patient satisfaction is achieved by promoting a client-centered orientation within organizations. At the root is management by fact. Decisions are made and actions carried out by translating data into information, not according to instinct, perceptions, or personal prejudices. Quality management uses the Plan-Do-Check-Act cycle as a simple model for its operation. The quality management's core value of respect for people achieves quality through full employee commitment and participation.



The QI story is a problem-solving process that is a systematic, data-based approach. Quality tools are used throughout the QI story steps. Eighty percent of problems can be solved with three analytical tools, 95 percent can be solved with seven tools (checksheet, Pareto chart, cause-and-effect diagram, graph, histogram, scatter diagram, control chart). Three questions help determine which tool to use. What does the team want to do with the tool? At which step in the QI story is the team? Does the team need to expand or to focus its thinking? The process goes through alternating exercises of expanding a team's thoughts on many different ideas or focusing its thoughts on specific ideas.

Training is a vital activity in quality management. The quality of the service provided is directly proportional to the amount of training staff receive. Lack of training provides poor quality in service, and poor quality in health services costs lives.

BEST READING

FOR PART TWO

A NEWBORN HEALTH INFORMATION SYSTEM

EPIDEMIOLOGY

Analytical Methods in Maternal and Child Health, Division of Science, Education , and Analysis, Maternal and Child Health Bureau, Health Resources and Service Administration, May 1998.

Gregg, M.B. Field Epidemiology. New York; Oxford University Press, Inc. 1996.

Haddix, A.C., Teutsch, S.M., Shaffer P.A., Dunet D.O. Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation, New York; Oxford University Press, Inc. 1996.

Last, J.M., International Epidemiological Association. A Dictionary of Epidemiology. Oxford: Oxford University Press, Inc.; 1983.

Second interagency meeting on reproductive health indicators for global monitoring. Geneva, 17-19 July 2000. Background paper.

Stroup, D.F., Teutsch, S.M. Statistics in Public Health, New York; Oxford University Press, Inc. 1998.

Teutsch, S.M., Churchill, R.E. Principles and Practice of Public Health Surveillance. New York; Oxford University Press, Inc. 2000.

UNICEF/WHO/UNFPA. Guidelines for monitoring the availability and use of obstetric services. August1997.

U.S. Department of Health and Human Services. Principles of Epidemiology, 2nd Edition: CDC Atlanta, GA 1992.

Vaughn, J.P., Morrow, R.H . Manual of Epidemiology for District Health Management. Geneva: World Health Organization; 1989.

WHO. Reproductive health Indicators for global monitoring indicator profiles. Department of Reproductive Health and Research, WHO.

Wingo, P.A., Higgins, J.E., Rubin, G.L., Zahniser, S.C. An Epidemiologic Approach to Reproductive Health: CDC, Atlanta, GA 1991.

QUALITY MANAGEMENT

Smith, L. Introduction to total quality management participant workbook, Atlanta, GA: CDC; 1996.

Tague, N.P. The quality toolbox. Milwaukee, WI: ASQ Quality Press; 1995.

USAID QAP/CORE/CSTS. Quality Assurance of Health Care in Developing Countries. June 1999.

U.S. Department of Health and Human Services. Program Management: A Guide for Improving Program Decisions: CDC Atlanta, GA 1986.

REFERENCES
FOR PART TWO

(1) U.S. Department of Health and Human Services. Program Management: A Guide for Improving Program Decisions: CDC Atlanta, GA 1986.

(2) 1. Last, J.M., International Epidemiological Association. A Dictionary of Epidemiology. Oxford: Oxford University Press, Inc.; 1983.

(3) Wingo, P.A., Higgins, J.E., Rubin, G.L., Zahniser, S.C. An Epidemiologic Approach to Reproductive Health:, Centers for Disease Control, Atlanta, GA, 1991, pp 69.

(4) Analytical Methods in Maternal and Child Health, Division of Science, Education , and Analysis, Maternal and Child Health Bureau, Health Resources and Service Administration, May 1998, pp 18

(5) Stroup, D.F., Teutsch, S.M. Statistics in Public Health, New York; Oxford University Press, Inc. 1998, pp 172-177.

(6) U.S. Department of Health and Human Services. Principles of Epidemiology, 2nd Edition: pp 209, GA 1992.CDC Atlanta,,

(7) Hennekens, C.H., Buring, J.E. Epidemiology in Medicine: Little, Brown and Company, Boston, 1987,pp 331.

(8) Lilienfield AM, Lilienfeld DE, Foundations of Epidemiology, 2nd Edition, New York; Oxford University Press, Inc., 1980 pp. 217

(9) Gregg, M.B. Field Epidemiology. New York; Oxford University Press, Inc. 1996, pp 60-80

(10) Teutsch, S.M., Churchill, R.E. Principles and Practice of Public Health Surveillance. New York; Oxford University Press, Inc. 2000. pp 116-126

(11) Vaughn, J.P., Morrow, R.H . Manual of Epidemiology for District Health Management. Geneva: World Health Organization; 1989 pp 100-109.

(12) Smith, L. Introduction to total quality management participant workbook, Atlanta, GA: CDC; 1996.

(13) Tague, N.P. The quality toolbox. Milwaukee, WI: ASQ Quality Press; 1995, pp 1-7.

(14) USAID QAP/CORE/CSTS. Quality assurance of health care in developing countries. June 1999.